REVISED DRAFT EXPANDED SITE
INSPECTION REPORT

DENTON AVENUE LANDFILL
NEW HYDE PARK, NASSAU COUNTY,
NEW YORK
EPA ID NO. NY981186919

Volume II

EPA CONTRACT NO.: 68-W9-0024
WORK ASSIGNMENT NO.: 057-2JZZ
DOCUMENT CONTROL NO.: 7720-057-LR-BZCT

June 14, 1994

PREPARED FOR:

U.S. Environmental Protection Agency
26 Federal Plaza
New York, New York 10278

PREPARED BY:

CDM FEDERAL PROGRAMS COPORATION

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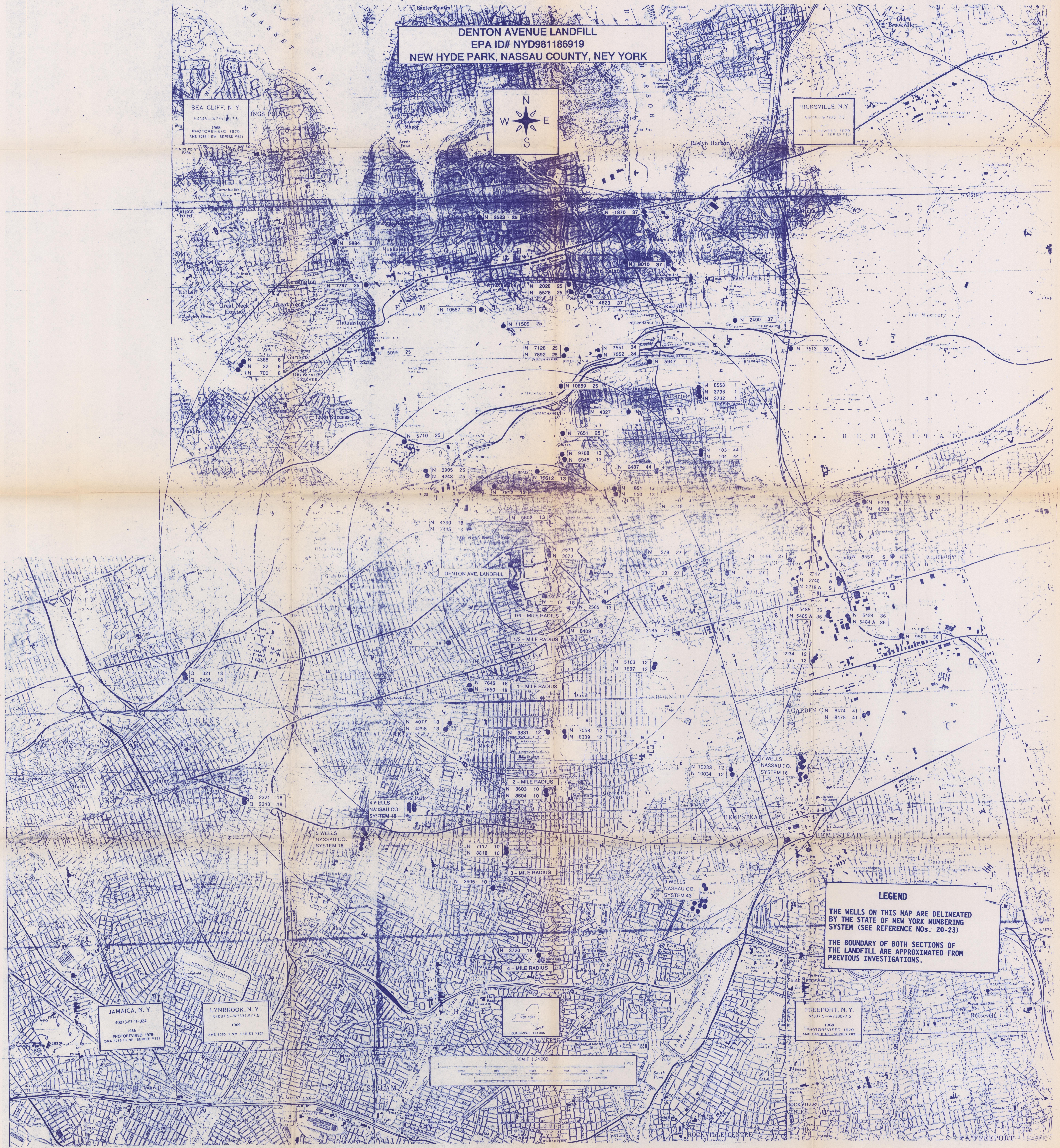
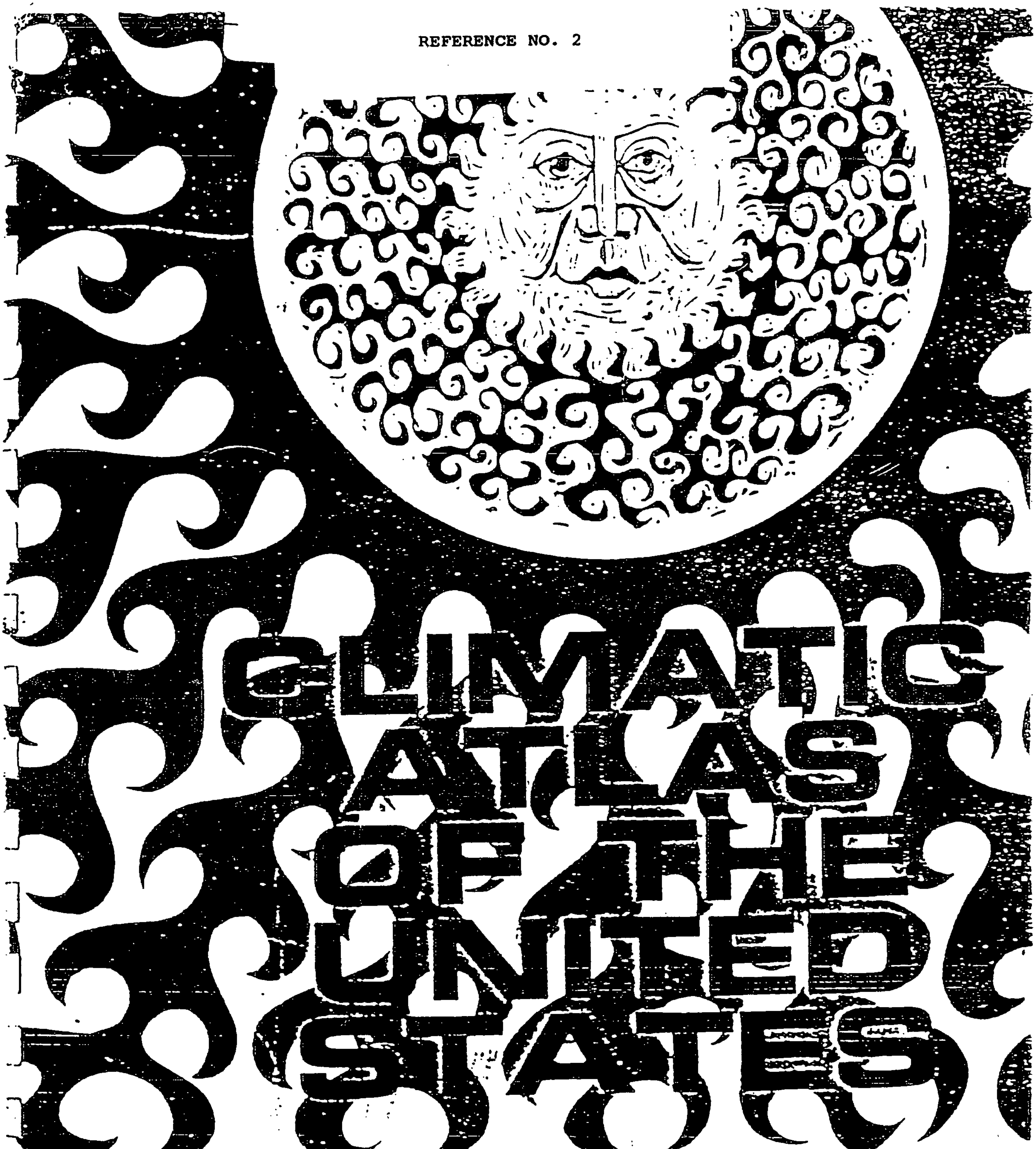
REFERENCES

(No.s 1 to 18)



DENTON AVENUE LANDFILL
EPA ID# NYD981186919
NEW HYDE PARK, NASSAU COUNTY, NEY YORK
N
W
E
S
SEA CLIFF, N.Y.
HICKSVILLE, N.Y.
DENTON AVE. LANDFILL
1/4 - MILE RADIUS
1/2 - MILE RADIUS
1 - MILE RADIUS
2 - MILE RADIUS
3 - MILE RADIUS
4 - MILE RADIUS
JAMAICA, N.Y.
LYNBROOK, N.Y.
FREEPORT, N.Y.
N4037.5—W7330/7.5
1969
PHOTOREVISED 1979
AMS 6265 II NE—SERIES V821
HEMPSTEAD
LEGEND
THE WELLS ON THIS MAP ARE DELINEATED BY THE STATE OF NEW YORK NUMBERING SYSTEM (SEE REFERENCE NOs. 20-23)
THE BOUNDARY OF BOTH SECTIONS OF THE LANDFILL ARE APPROXIMATED FROM PREVIOUS INVESTIGATIONS.
SCALE 1:24 000

REFERENCE NO. 2



onmental Science Services Administration . Environmenta

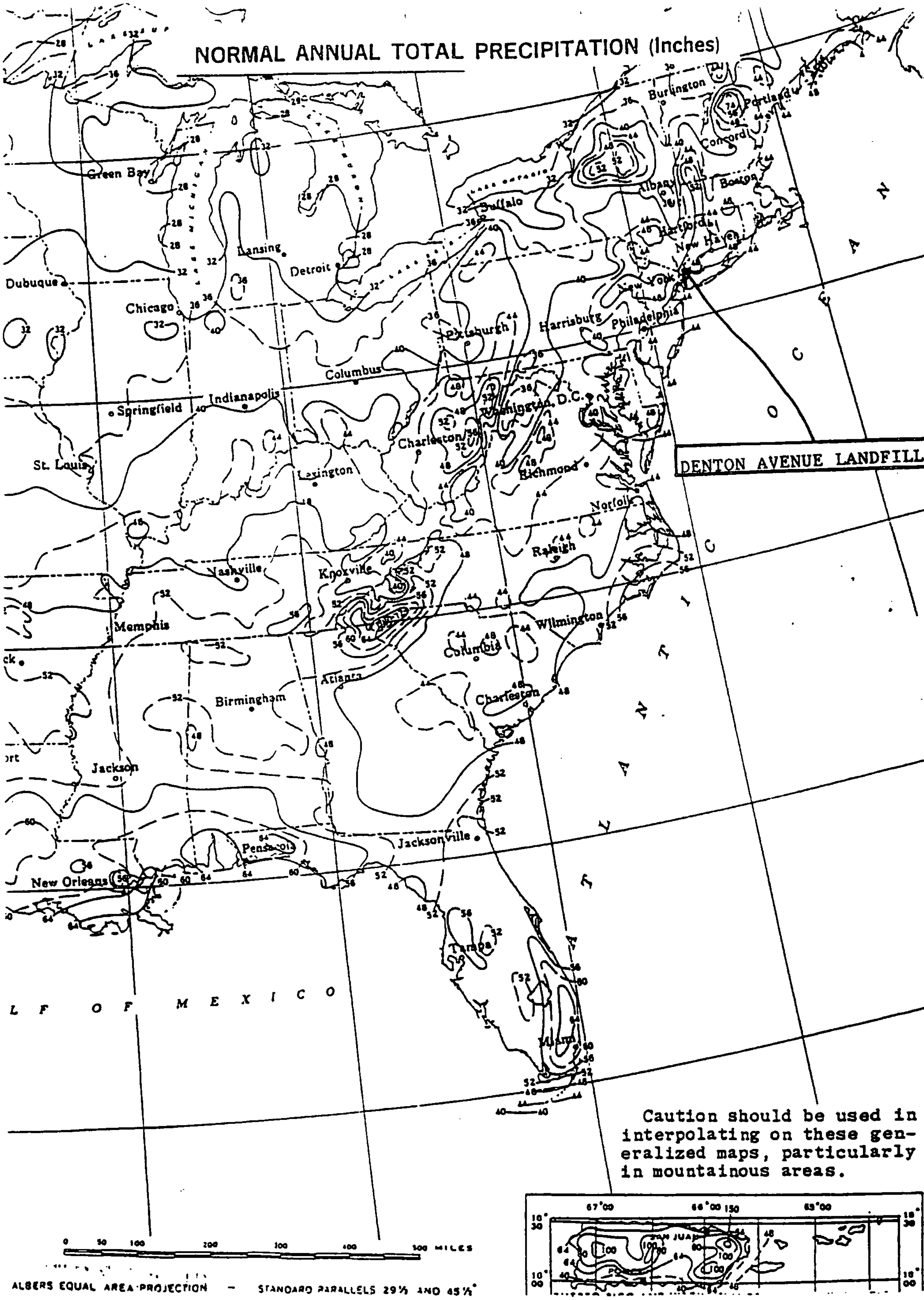
U.S. DEPARTMENT OF COMMERCE
C. R. Smith, Secretary

ENVIRONMENTAL SCIENCE SERVICES ADMINISTRATION
Robert M. White, Administrator

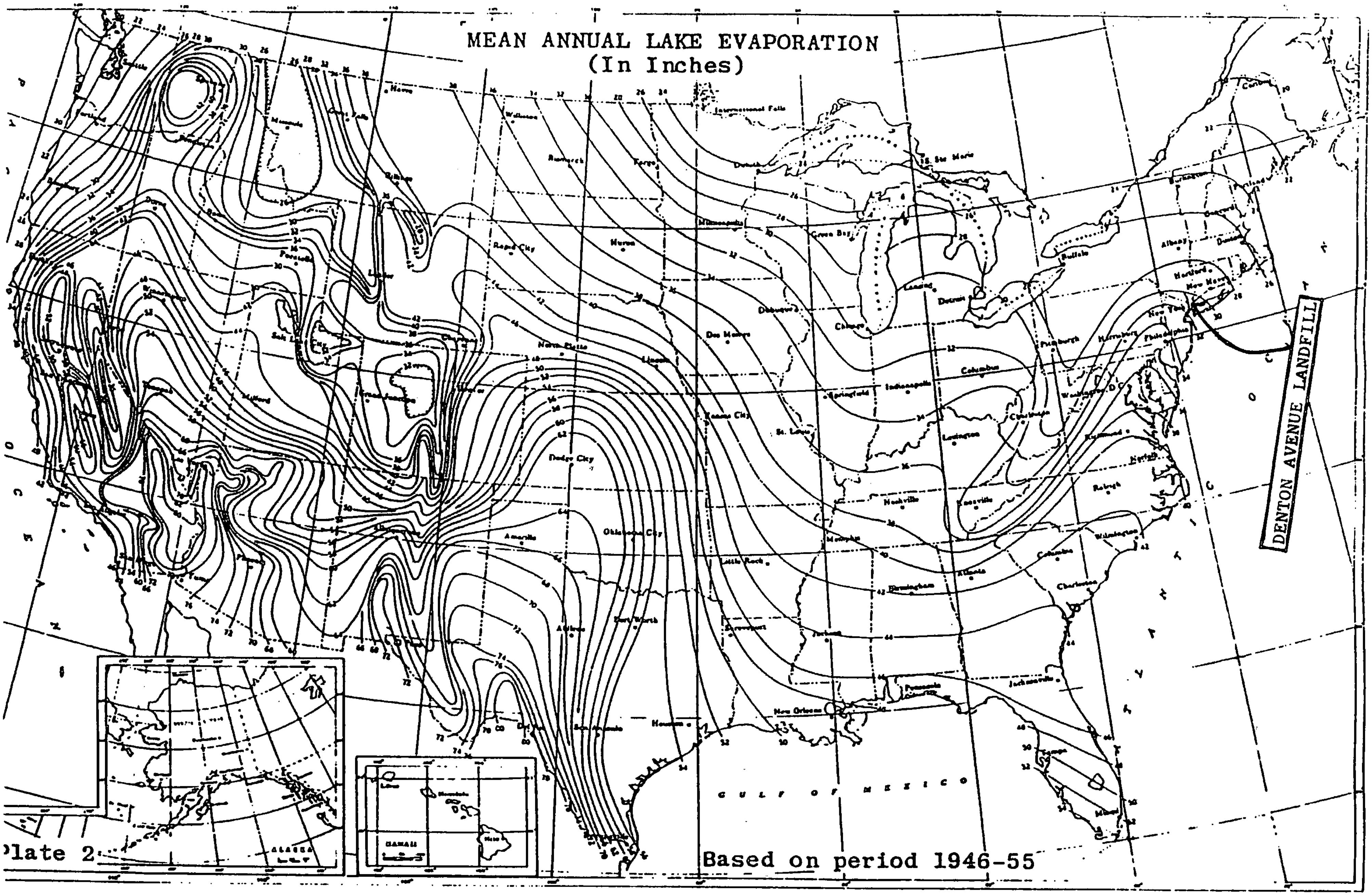
ENVIRONMENTAL DATA SERVICE
Woodrow C. Jacobs, Director

JUNE 1968

REPRINTED BY THE
NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION
1983


NORMAL ANNUAL TOTAL PRECIPITATION (Inches)
DENTON AVENUE LANDFILL
Green Bay
Lansing
Detroit
Dubuque
Chicago
Buffalo
Burlington
Portland
Concord
Albany
Boston
Hartford
New Haven
New York
Philadelphia
Harrisburg
Pittsburgh
Columbus
Indianapolis
Springfield
St. Louis
Washington, D.C.
Charleston
Richmond
Lexington
Norfolk
Raleigh
Nashville
Knoxville
Memphis
Wilmington
Columbia
Atlanta
Birmingham
Charleston
Jackson
Jacksonville
Pensacola
New Orleans
Tampa
Miami
L F O F M E X I C O
Caution should be used in interpolating on these generalized maps, particularly in mountainous areas.
0 50 100 200 300 400 500 MILES
ALBERS EQUAL AREA PROJECTION — STANDARD PARALLELS 29½ AND 45½°

p.43


MEAN ANNUAL LAKE EVAPORATION
(In Inches)
DENTON AVENUE LANDFILL
GULF OF MEXICO
Plate 2
Based on period 1946-55

TECHNICAL PAPER NO. 40

RAINFALL FREQUENCY ATLAS OF THE UNITED STATES

for Durations from 30 Minutes to 24 Hours and Return Periods from 1 to 100 Years

Prepared by
DAVID M. HERSHFIELD
Cooperative Studies Section, Hydrologic Services Division
for
Engineering Division, Soil Conservation Service
U.S. Department of Agriculture

REFERENCE NO. 3

PRICE LIST: RAINFALL FREQUENCY ATLASES

October 1985

The atlases described below may be ordered on one reel of 35mm microfilm at $12.50, or as individual paper pages at $2 per page, $4 service and handling charge per order. (Prices subject to change without notice.) Call to confirm current price.

National Climatic Data Center
Federal Building
Asheville, NC 28801-2696
704 CLI-MATE or 704-259-0682
Telex 6502643731

MasterCard AMERICAN EXPRESS VISA

TP-40: Rainfall Frequency Atlas of the US - Weather Bureau Technical Paper No. 40 (Washington, DC: GPO, 1961) 14x21 ins, paper cover, 61 pages. (Superseded in part by two publications listed below.)

Presents 49 US rainfall frequency maps for selected durations from 30 minutes to 24 hours and return periods from 1 to 100 years. OUT-OF-PRINT, but a 8 1/2x14 in. reduced photocopy priced at $15 is available from the NCDC address above. Make payment to "Commerce-NOAA-NCDC".

HYDRO-35: Five- to 60-Minute Precipitation Frequency for the Eastern and Central US - NOAA Technical Memorandum NWS HYDRO-35 (Silver Spring, MD: NWS, 1977) 8 1/2x11 ins, cardstock cover, 36 pages. (Supersedes TP-40 above for the eastern 2/3 of the US for durations of 1 hr. and less).

Presents 6 US rainfall frequency maps for durations of 5, 15 and 60 minutes at return periods of 2 and 100 years. Equations are given to derive 10- and 30-min values between 2 and 100 years.

Order from: National Technical Info. Svc.
5285 Port Royal Rd.
Springfield, VA 22161
Order Desk Phone: 703-487-4650

Order No : PB 272-112
Prices: Paper $8.50
Microfiche $4.50

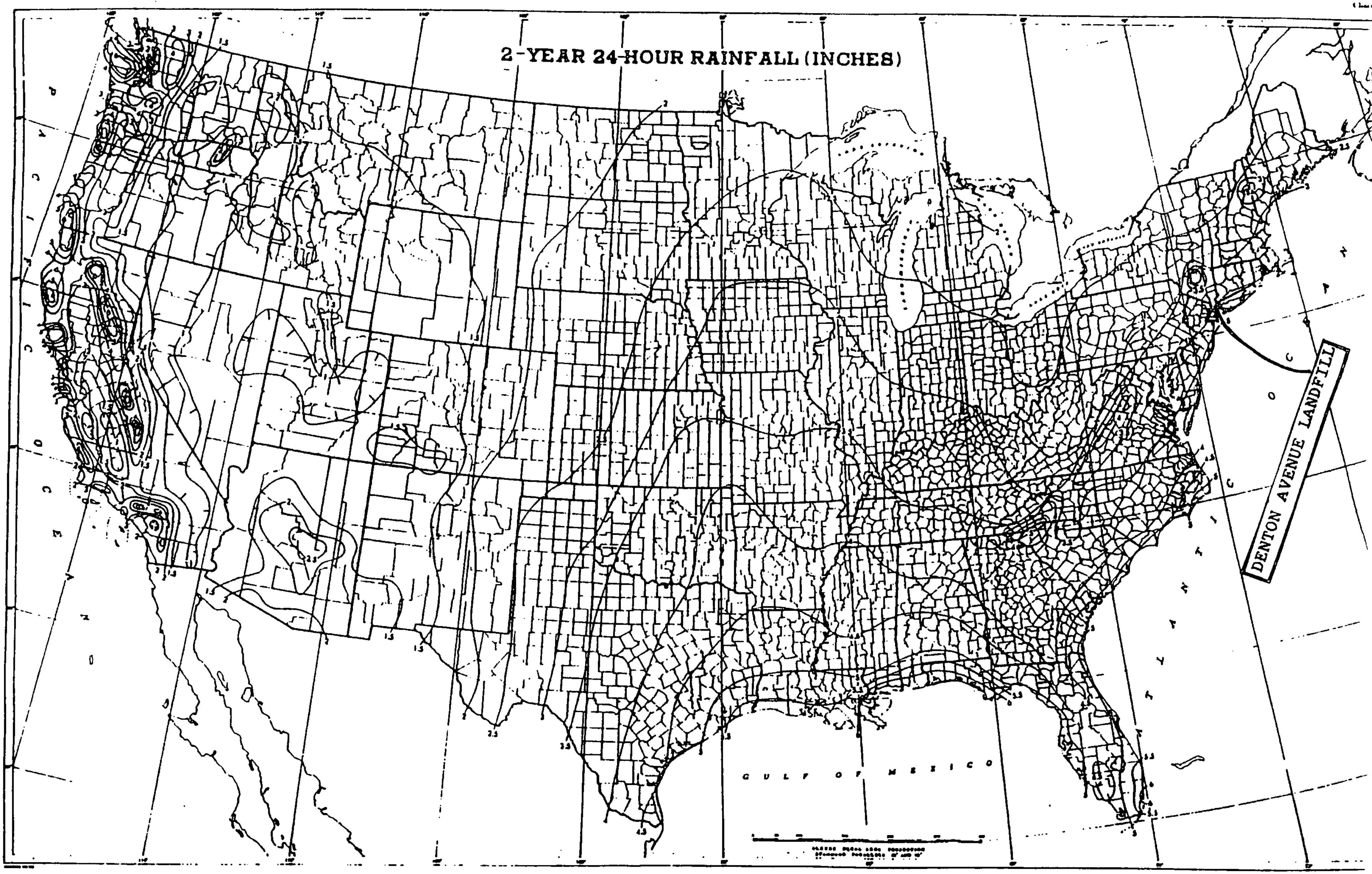
NOAA Atlas 2: Precipitation Frequency Atlas of the Western US (Washington, DC: GPO, 1973) 16x22 ins, cardstock cover, 11 Vols (Supersedes TP-40 above for the 11 western states) OUT OF PRINT.

This atlas contains maps for the 6- and 24-hour durations for return periods of 2, 5, 10, 25, 50, and 100 years. All maps are prepared on the same 1:2,000,000 scale.

Vol.	State	Pages	Photocopy Price
I	Montana	34	$ 68.00
II	Wyoming	34	$ 68.00
III	Colorado	47	$ 94.00
IV	New Mexico	34	$ 68.00
V	Idaho	35	$ 70.00
VI	Utah	46	$ 92.00
VII	Nevada	35	$ 70.00
VIII	Arizona	33	$ 66.00
IX	Washington	35	$ 70.00
X	Oregon	35	$ 70.00
XI	California	48	$ 96.00

(Note: Topographic contours and city names not always legible on microprints of NOAA Atlas 2. Blank, numbered pages are not reproduced, resulting in apparent missing pages, but no data pages are missing.)

$4 SERVICE AND HANDLING CHARGE PER ORDER.



2-YEAR 24-HOUR RAINFALL (INCHES)
DENTON AVENUE LANDFILL
GULF OF MEXICO
P A C I F I C O C E A N
A T L A N T I C O C E A N

REFERENCE NO. 4

Appendix 1.1-2

RECEIVED APR 7 1986

e1d6

INTERVIEW ACKNOWLEDGEMENT FORM

Site Name: Denton Avenue Landfill

I.D. Number: 130008

Person Contacted: Mr. Robert F. Dolan

Date: 20 January 1986

Title: Town Attorney

Affiliation: Town of North Hempstead

Phone No.: (516) 627-0590

Address: 220 Plandome Road
Manhasset, New York 11030

Persons Making Contact:
EA Representatives:

Shultz/Ligotino

Type of Contact: In person

Interview Summary:

Messrs. Dolan and Perro showed us aerial photographs of the Denton Avenue Landfill site and described the various aspects of the site to give us an understanding of the physical layout of the facility, as well as the changes which have taken place there over the years. An area along Evergreen Street is where the original Denton Avenue Landfill was located. It is now ballfields, a physical activity center, and a stadium. Development of the athletic facility began in 1978. The only problems encountered at this original landfill site have been related to land settling. The former locations of an original incinerator, a second incinerator, and an addition to that were established. Considerable changes have taken place on the property. A public works office and highway garage are standing where the incinerators were.

A county recharge basin was pointed out, and on the other side of this, the location of the second landfill was established. The second landfill occupied an area of about 27 acres--an old mining area-- (based on a survey that was conducted in 1962 when the land was purchased). In the late 1960s or early 1970s, fill from excavation activity at extensions to the Northern State Parkway was used to cap this area. When the "cap" was applied, landfill gases emigrated into nearby houses, so vents had to be installed. There have not been any problems with gas since then. A police boy's club and senior citizens facility, and an organic garden have been built on this parcel. Also on this parcel is an old driving range, and an area formerly used by area residents for organic gardens.

It is estimated that the Denton Avenue Landfill took in 350-400 tons of garbage per day. The incinerators at the site were to have burned most of that, but were closed down in 1977 when EPA changed tha air standards for the area. Actually, the incinerator burned a large portion of the raw garbage while they were in operation, and it is unknown how much raw garbage may have gone into the landfill.

An ERM report (by a Mr. John DePhillipi) indicates that the southern landfill parcel operated from about 1953 to 1963, and that the northern landfill parcel operated from 1963 until it reached capacity and closed in 1966. A Fred C. Hart site inspection form (dated 1980) indicates the period of site operations to be 1951-1974. Mr. Dolan indicated that the northern landfill

8296

parcel was purchased in 1962. Mr. Perro indicated that the timeframes presented in each report were probably not contradictory--that the site (probably) stopped taking raw garbage in 1966, and that the area was (probably) capped in 1974. Mr. Perro indicated that the Town of North Hempstead purchased the southern parcel in (about) 1950 and started operations in 1951. The incinerator had been privately-owned prior to this. There is no way of knowing what garbage went to the property before it became property of the Town. Former owners of portions of the southern area include Flatland Sand and Gravel, and Colonial Sand and Stone Co. (there were small sand pits and mining operations at the site as early as 1942-43.) The former owner (reputed) of the northern area was Eugene L. De Pasquale. Mr. Pasquale had obtained the property from Colonial Sand and Stone Co. The reported date of final closure (1974) coincides with the startup of a landfill in Port Washington. After 1974, incinerator residue was only stored overnight at the Denton Avenue landfill, then transported to the Port Washington landfill.

There have been monitoring wells installed at the Denton Avenue landfill site; however, Mssrs. Dolan and Perro were not sure if the town is currently monitoring them. Past sampling results would have been submitted to the DOH. Information would be available from the Department of Public Works. There are no residential wells nearby--all supply is by private water districts. The Jamaica Water Supply, and the Garden City Park Water District both have wells nearby. A Mr. Robert Banks, Commissioner of Garden City Park Water District could elaborate. He can be reached through the Manahasset Highway Department.

The facility was backfilled to grade with garbage--there was no mounding. The depth of cover (fill) on the old landfill is unknown. The new landfill has approximately 3-4 feet of cover. Scraps of metal and wood have been found during excavation for the swimming pool. Ash was deposited in the old landfill primarily in the area where the stadium was built.

Additional information received from Mr. Dolan included: 10 September 1962. Blueprint map of real property to be acquired by the Town of North Hempstead to be used for sanitary landfill...

7 February 1984. Topographical map of northern landfill area. Prepared by Charles E. Ward, Inc.

Aerial Photographs (date unknown.)

<u>Acknowledgement</u>:

I have read the above transcript and I agree that it is an accurate summary of the information verbally conveyed to EA Science and Technology interviewers, or as I have revised below, is an accurate account.

p. 3 of 6

Revisions (please write in corrections to above transcript):

Signature: [signature] Town Attorney **Date:** 4-3-86

RECEIVED APR 23 1986

INTERVIEW ACKNOWLEDGEMENT FORM

Site Name: Denton Avenue Landfill

I.D. Number: 130008

Person Contacted: Mr. Clyde Perro

Date: 20 January 1986

Title: Commissioner of Solid Waste

Affiliation: Town of North Hempstead

Phone No.: (516) 621-0906

Address: 220 Plandome Road
Manhasset, New York 11030

Persons Making Contact:
EA Representatives:

Shultz/Ligotino

Type of Contact: In person

Interview Summary:

Messrs. Dolan and Perro showed us aerial photographs of the Denton Avenue Landfill site and described the various aspects of the site to give us an understanding of the physical layout of the facility, as well as the changes which have taken place there over the years. An area along Evergreen Street is where the original Denton Avenue Landfill was located. It is now ballfields, a physical activity center, and a stadium. Development of the athletic facility began in 1978. The only problems encountered at this original landfill site have been related to land settling. The former locations of an original incinerator, a second incinerator, and an addition to that were established. Considerable changes have taken place on the property. A public works office and highway garage are standing where the incinerators were.

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p.5 of 6

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Aerial Photographs (date unknown.)

<u>Acknowledgement</u>:

I have read the above transcript and I agree that it is an accurate summary of the information verbally conveyed to EA Science and Technology interviewers, or as I have revised below, is an accurate account.

p6of6

Revisions (please write in corrections to above transcript):

Signature: Clyde W. Renof. Date: 4-21-86

REFERENCE NO. 5

ENGINEERING INVESTIGATIONS AT INACTIVE HAZARDOUS WASTE SITES

FILE COPY

PHASE 1 INVESTIGATION

Denton Avenue Landfill

Site No. 130008

Town of North Hempstead, Nassau County

Final - June 1987

New York State Department of Environmental Conservation

50 Wolf Road, Albany, New York 12233
Henry G. Williams, Commissioner

Division of Solid and Hazardous Waste
Norman H. Nosenchuck, P.E., Director

Prepared by:

EA SCIENCE AND TECHNOLOGY

A Division of EA Engineering, Science, and Technology, Inc.

EA REPORT DEC63A

ENGINEERING INVESTIGATIONS AT INACTIVE HAZARDOUS WASTE SITES IN THE STATE OF NEW YORK PHASE I INVESTIGATIONS

DENTON AVENUE LANDFILL
TOWN OF NORTH HEMPSTEAD, NASSAU COUNTY
NEW YORK I.D. NO. 130008

Prepared for

Division of Solid and Hazardous Waste
New York State Department of Environmental Conservation
50 Wolf Road
Albany, New York 12233-0001

Prepared by

EA Science and Technology
R.D. 2, Goshen Turnpike
Middletown, New York 10940

A Division of EA Engineering, Science, and Technology, Inc.

December 1986

CONTENTS

Site Coordinates:

Latitude: 40° 44' 57"
Longitude: 73° 40' 32"

DENTON AVENUE LANDFILL

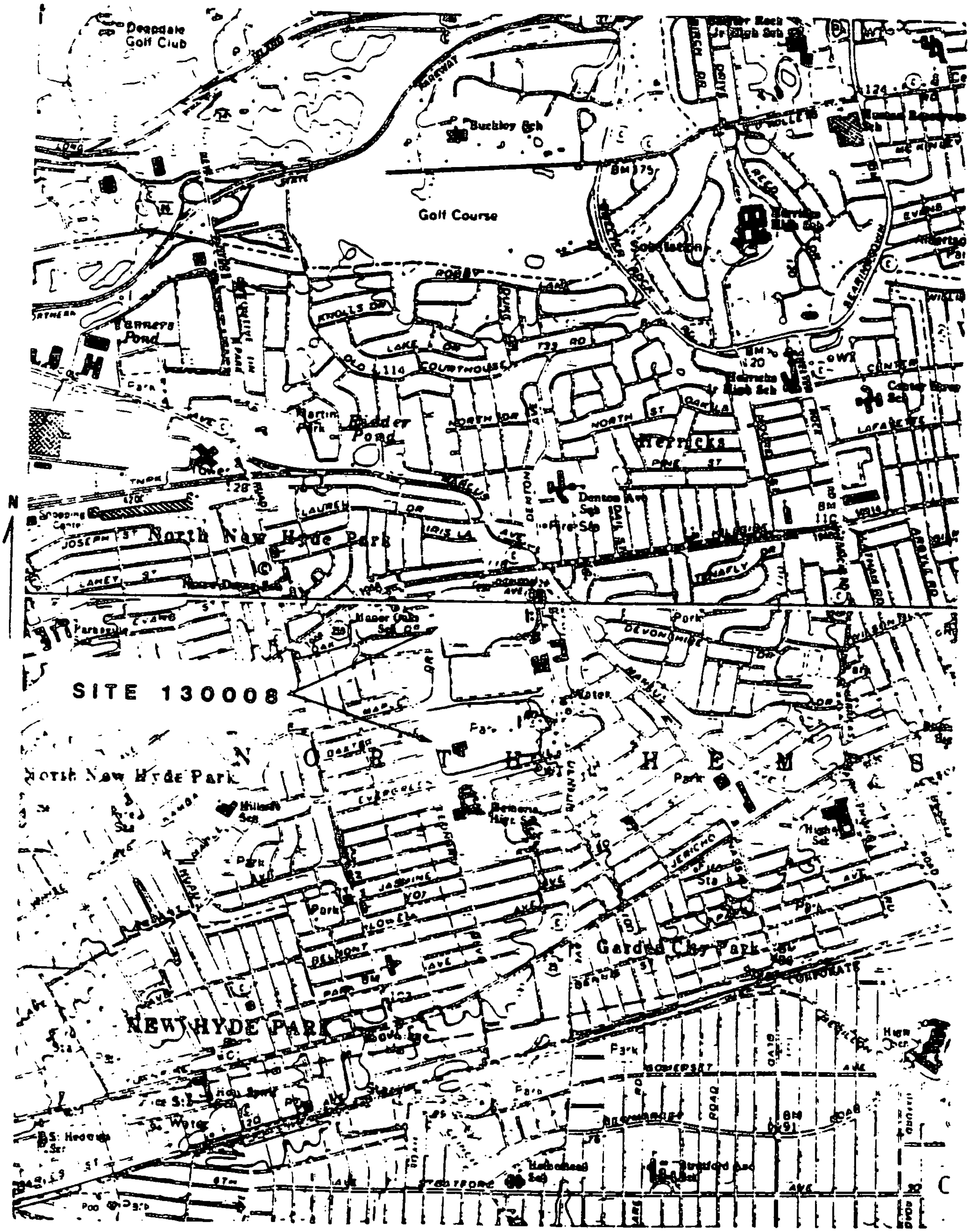


Figure 1-1. LYNBROOK & SEA CLIFF QUADS.

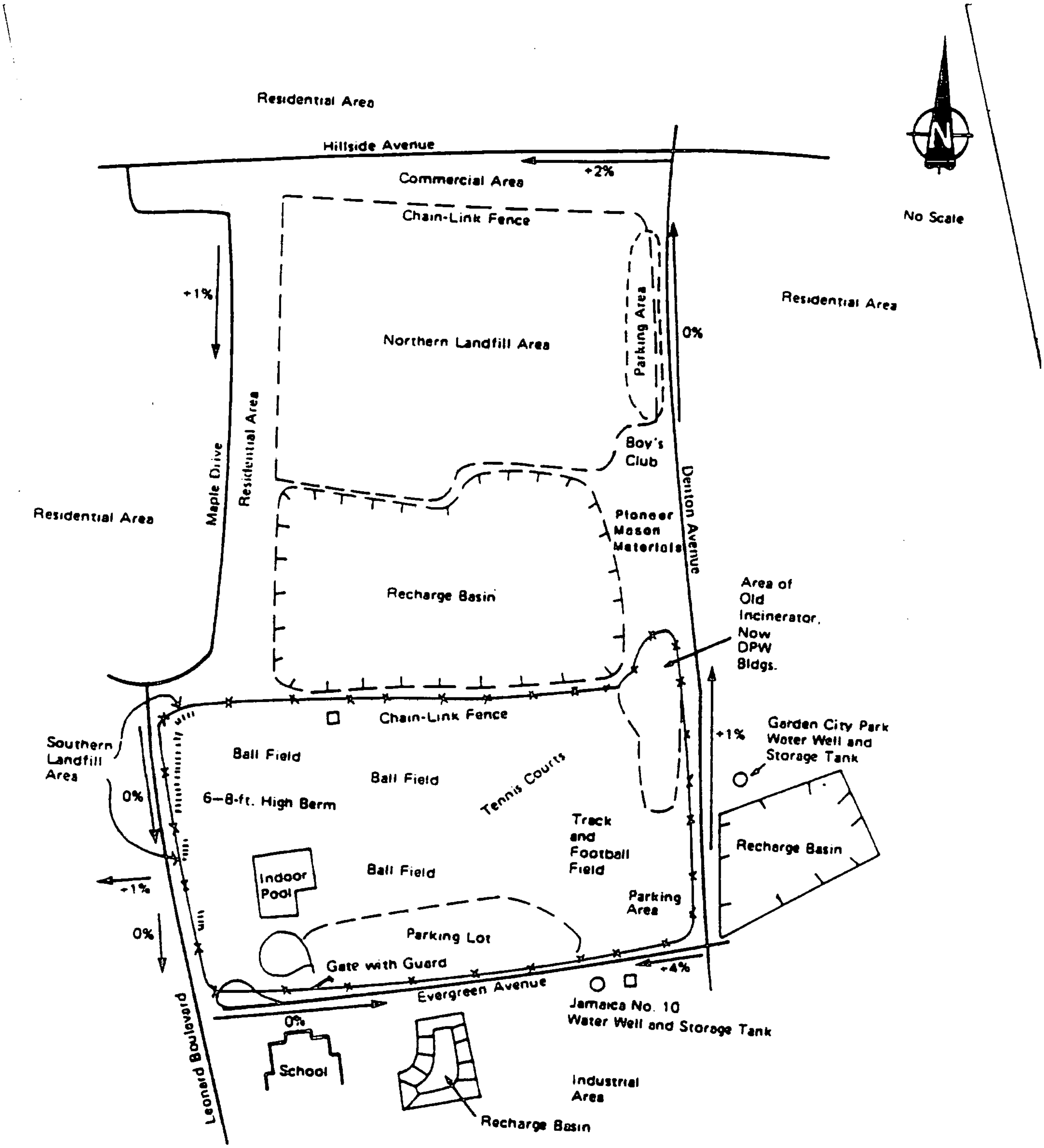
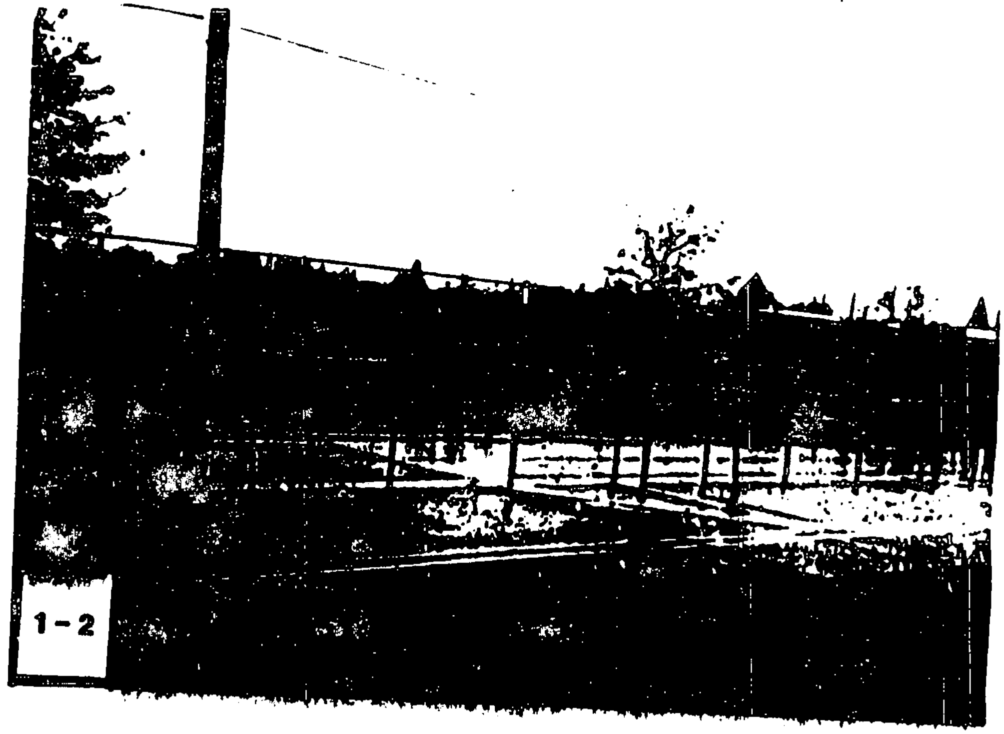


Figure 1-2. Site sketch. Denton Avenue Landfill, 20 January 1986.

1 - 1



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1 - 3

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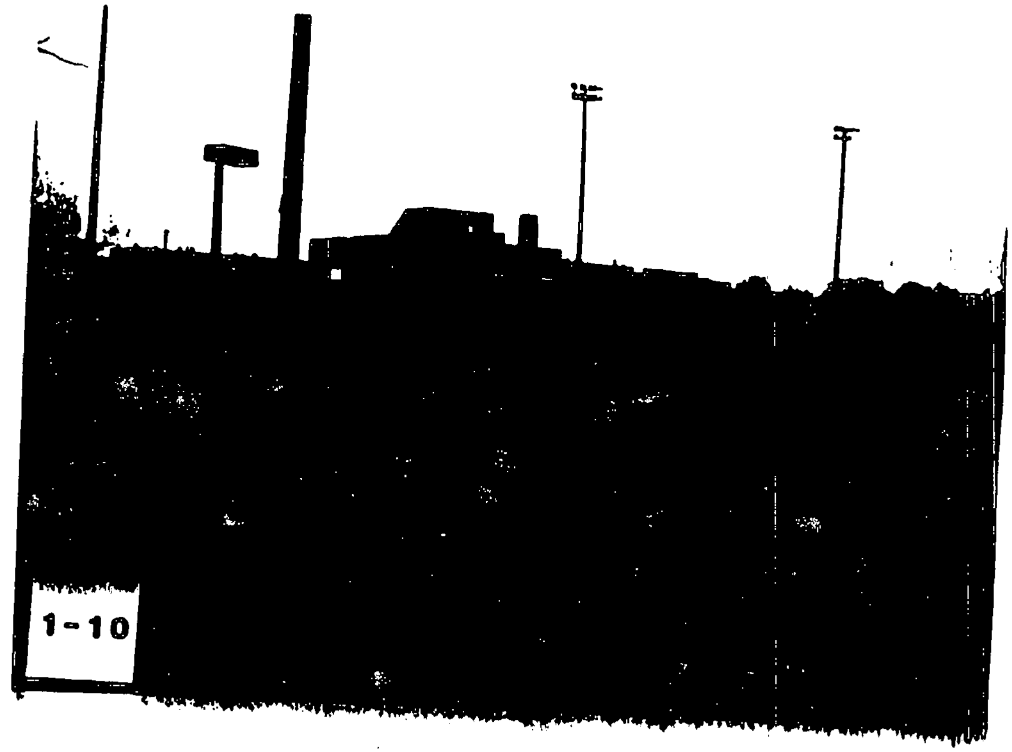
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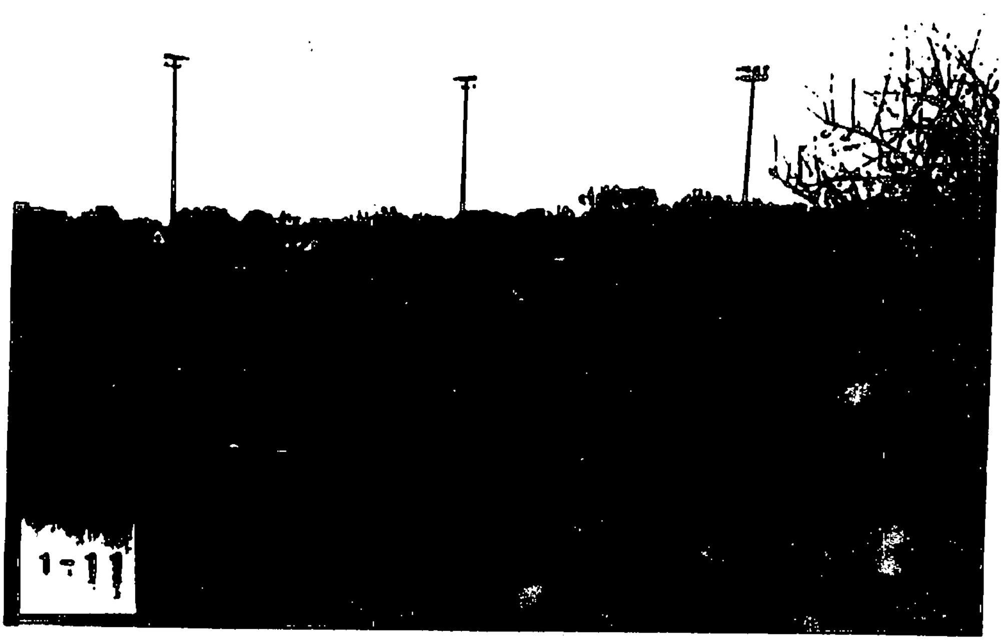
1-11


1-12

DENTON AVENUE LANDFILL - PHOTO LOG

Photo	Description
1-1 and 1-2	West-northwest view across the northern landfill area from Denton Avenue (Figure 1-1). Residences along Maple Drive are visible in the distance in Photo 1-1. Commercial establishments along Hillside Avenue are visible in the right portion of Photo 1-2.
1-3 thru 1-11	Panoramic view (320°) from the northern border of the southern landfill at the southwest corner of the large recharge basin that separates the two landfill areas.
1-3	Northwest view across the southwestern corner of the recharge basin to residences located along Maple Avenue.
1-4	North view across the recharge basin to the northern landfill area. Far buildings in the photo are the buildings along Hillside Avenue. In the left portion of the photo are a chain of black pipes which are the methane vents located along the western edge of the northern landfill.
1-5	Northeast view across the recharge basin.
1-6	East-northeast view across the eastern portion of the recharge basin towards Denton Avenue (Figure 1-2).
1-7	East view along the northern edge of the southern landfill area to the Garden City Park Water District storage tank located along Denton Avenue. Tennis courts are located in the center right of the photo.
1-8	Southeast view across the southern landfill area to the Jamaica Water District storage tank located along Evergreen Avenue (Figure 1-2). A ball field, part of the athletic complex built above the landfill, is in the center of the photo. The ball field is lower in elevation than the surrounding terrain. Tennis courts are located in the center left of the photo.
1-9	South view across the southern landfill area to the parking lot inside the Evergreen Avenue entrance to the athletic facility. The ball field is in the left center portion of the photo.
1-10	Southwest view across the southern landfill area towards Evergreen Avenue (Figure 1-2). The facility in the center of the photo houses the indoor swimming pool. In the distance, center left of the photo, is the school located along the south side of Evergreen Avenue. Homes along Leonard Boulevard are center right in the photo.
1-11	West-southwest view across the southern landfill area to the homes located along Leonard Boulevard. The athletic field built above the northwestern corner of the southern landfill is visible.
1-12	North view along Leonard Boulevard of the western perimeter of the southern landfill area. Monitoring wells located in this area were not visible during EA's site inspection.

1. EXECUTIVE SUMMARY

The Denton Avenue Landfill site (New York I.D. No. 130008; EPA I.D. No. NYD981186919), located southwest of the intersection of Denton and Hillside Avenues in New Hyde Park, is an inactive landfill that operated from 1953 to 1966 (Figures 1-1 and 1-2; Photos 1-1 through 1-8). The property, owned by the Town of North Hempstead, consists of two 27-acre rectangular plots separated by a large recharge basin. Both landfills were constructed in old sand pits excavated close to the water table. There is no documentation of hazardous waste disposal at the landfill and the superintendent of the Town's Sanitation Department has described the waste material, in general, as municipal refuse. The southernmost landfill was closed in 1963. Upon closure of the northern landfill in 1966, a clayey fill material was applied to 90 percent of the landfill surface. Soon thereafter, methane gas began migrating into nearby homes. In the early 1970s, vents were installed in the affected homes, a trench backfilled with crushed rock was installed on the northern edge of the landfill, and vent pipes were sunk into the landfill mass to alleviate the problem. The Town of North Hempstead agreed to monitor gas on a weekly basis, and methane gas continued to be a problem at the northern landfill throughout the 1970s. In 1980, air monitoring of several other contaminants revealed only the presence of methane in the ground. In 1982, five ground-water monitoring wells were installed downgradient of both landfills and sampling revealed elevated concentrations of ammonia, lead, iron, dimethylnaphthalene, and several phthalates. For the purpose of HRS scoring, iron was used to confirm a release to ground water. A Nassau County Department of Health consultant, upon reviewing the analytical data, concluded that a plume of ground water contaminated by iron and lead has migrated at least 800 ft downgradient of the north landfill site. Currently, the Denton Avenue Landfill property is the site of the North Hempstead recreational facility. Neither methane gas nor ground water is currently sampled.

The HRS scores are as follows: Migration Score (S_M) = 35.35, (S_{gw} = 61.15; S_{sw} = 0; S_a = 0), the highest attainable for this site; Fire and Explosion Score (S_{FE} = N/A), and Direct Contact Score (S_{DC}) = 0, because the northern fill area has reportedly been covered with more than 2 ft of capping material and the southern fill area appears to be adequately covered. There is a confirmed release of contaminants (iron) to the ground water. It is recommended that the next step of site investigation involve the evaluation of the horizontal and vertical extent of the ground-water contamination. This is beyond the scope of a Phase II study, and therefore, performance of a Phase II investigation is not recommended for this site.

2. PURPOSE

The Denton Avenue Landfill site was listed in the New York State Registry of Inactive Hazardous Wastes Sites because it is an inactive landfill and ground water downgradient of the site contains low levels of contaminants.

The goal of the Phase I investigation of this site was to: (1) obtain available records on the site history from state, federal, county, and local agencies; (2) obtain information on site topography, geology, local surface water and ground-water use, previous contamination assessments, and local demographics; (3) interview site owners, operators, and other groups or individuals knowledgeable of site operations; (4) conduct a site inspection to observe current conditions; and (5) prepare a Phase I report. The Phase I report includes a Hazard Ranking Score (HRS) and an assessment of the available information.

3. SCOPE OF WORK

The Phase I investigation of the Denton Avenue Landfill site involved a site inspection by EA Science and Technology, as well as record searches and interviews. The following agencies or individuals were contacted:

Contact	Information Received
Mr. Robert Dolan Town Attorney Town of North Hempstead 220 Plandome Road Manhasset, New York 11030 (516) 627-0590	Site History
Mr. Clyde Perro Commissioner of Solid Waste Town of North Hempstead 220 Plandome Road Manhasset, New York 11030 (516) 621-0906	Site History
Mr. Anthony Candela, P.E. Senior Sanitary Engineer New York State Department of Environmental Conservation Divison of Solid Waste SUNY Campus - Building 40 Stony Brook, New York 11794 (516) 751-7900	Site file
Mr. Larry Sema, P.E. Public Health Engineer Office of Industrial and Hazardous Waste Management Nassau County Department of Health 240 Old Country Road Mineola, New York 11501 (516) 535-2406	Site file

Contact	Information Received
Mr. Howard Schaefer/Mr. Robert Willis Public Health Sanitarians Office of Industrial and Hazardous Waste Management Nassau County Department of Health 240 Old Country Road Mineola, New York 11501 (516) 535-3314/535-2406	Site history
Mr. Kevin Walter, P.E. New York State Department of Environmental Conservation Division of Hazardous Waste Enforcement 50 Wolf Road Albany, New York 12233-0001 (518) 457-4346	No file/information
Mr. John Iannotti, P.E. New York State Department of Environmental Conservation Bureau of Remedial Action 50 Wolf Road Albany, New York 12233-0001 (518) 457-5637	No file/information
Mr. Earl Barcomb, P.E. New York State Department of Environmental Conservation Landfill Operations Vatrano Road Albany, New York 12205 (518) 457-2051	No file/information
Mr. Peter Skinner, P.E. New York State Attorney General's Office Room 221 Justice Building Albany, New York 12224 (518) 474-2432	No file/information
Mr. Ron Tramontano/Mr. Charlie Hudson New York State Department of Health Bureau of Toxic Substances Assessment Nelson A. Rockefeller Empire State Plaza Corning Tower Building, Room 342 Albany, New York 12237 (518) 473-8427	Site file

Contact	Information Received
Mr. James Covey, P.E. New York State Department of Health Nelson A. Rockefeller Empire State Plaza Corning Tower Building Albany, New York 12237 (518) 473-4637	Community Water Supply Atlas
Mr. Rocky Paggione, Atty./ Mr. Louis A. Evans, Atty. New York State Department of Environmental Conservation Division of Environmental Enforcement 202 Mamaroneck Avenue White Plains, New York 10601-5381 (914) 761-6660	No file/information
Mr. Marsden Chen, P.E. New York State Department of Environmental Conservation Bureau of Site Control 50 Wolf Road Albany, New York 12233-0001 (518) 457-0639	Site file
Mr. John W. Ozard Senior Wildlife Biologist New York State Department of Environmental Conservation Wildlife Resources Center Significant Habitat Unit Delmar, New York 12054 (518) 439-7486	Significant habitats
Mr. Perry Katz U.S. Environmental Protection Agency Region II Room 757 26 Federal Plaza New York, New York 10278 (212) 264-4595	No file/information
Mr. Don Myott Chief Officer Groundwater Management Nassau County Department of Health 240 Old Country Road Mineola, New York 11501 (516) 535-2201	Water Supply/Water Quality Information

Contact	Information Received
Mr. Doug Pica New York State Department of Environmental Conservation Division of Water SUNY Campus - Building 40 Stony Brook, New York 11794 (516) 751-7900	Well logs
Mr. Dave Bartow Assistant Fire Marshal Nassau County 899 Jerusalem Avenue Uniondale, New York 11553 (516) 566-5800	Information regarding the threat of fire and/or explosion at the site
Mr. Mirando Public Works Superintendent Garden City Water District 351 Stewart Avenue Garden City, New York 10923 (516) 742-5802	Public water supply information
Mr. Leonard Falco Superintendent Franklin Square Water District P.O. Box 177 Franklin Square, New York 11010 (516) FL4-0780	Public water supply information
Mr. Michael Steban Water Superintendent Manhasset - Lakeville Water District 170 East Shore Road Manhasset, New York 11030 (516) 466-4413	Public water supply information
Mr. Harold Morgan Town Engineer Town of Hempstead 220 North Plandome Road Manhasset, New York 11030 (516) 794-8300	Public water supply information
Mr. Becker Engineer Jamaica Water District 410 Lakeville Road Lake Success, New York 11042 (516) 488-4600	Public water supply information

Contact	Information Received
Mr. George Lee District Superintendent Albertson Water District 184 Shepherd Lane Roslyn Heights, New York 11577 (516) 621-3610	Public water supply information
Mr. Joseph Passariello District Supervisor Mineola Village Water District 167 Elm Place Mineola, New York 11501 (516) 746-0750	Public water supply information
Mr. Whiteside Superintendent Long Island Water Corporation 733 Sunrise Highway Lynbrook, New York 11563 (516) 593-1000	Public water supply information
Mr. Mahoney Port Washington Water District P.O. Box 432 38 Sandy Hollow Road Port Washington, New York 11050 (516) 707-0171	Public water supply information
Mr. Joseph Palogonia Superintendent West Hempstead - Hempstead Garden Water District 575 Birch Street West Hempstead, New York 11552 (516) 483-1180	Public water supply information

4. SITE ASSESSMENT - DENTON AVENUE LANDFILL

4.1 SITE HISTORY

The Denton Avenue Landfill site is an inactive landfill located approximately 0.5 mi north of the Village of New Hyde Park in the Town of North Hempstead, Nassau County, New York. The landfill consists of two separate 27-acre rectangular plots separated by a large recharge basin (Appendix 1.1-1). The Town of North Hempstead established the landfill in the early 1950s on the southern parcel, purchased from the Flatlands Sand and Gravel Company. This portion of the facility was closed in 1963 and is now the site of the North Hempstead recreational facility (EA Site Inspection, 20 January 1986 and Appendix 1.1-1). The northern landfill was developed in 1963 on property purchased from Eugene C. DePasquale in 1962. This landfill was closed in 1966 and is currently an undeveloped field (Appendixes 1.1-1 and 1.1-2). The material accepted at the Denton Avenue Landfill has been described by a superintendent of the Town's Sanitation Department as municipal refuse. The only waste accepted from industrial sources was wood and cardboard (Appendix 1.1-1). During routine site inspections in 1977, a NCDOH inspector observed that excavated refuse from the southern landfill consisted of well-decomposed material with only some larger wood pieces and plastic and metal material being visible (Appendix 1.1-3).

Landfilling operations began in the southern parcel in 1953 on property originally used as a sandpit by the Flatlands Sand and Gravel Company. The land was completely excavated to at least 45 ft below grade. In some portions of the property, ponded water was observed by eyewitnesses, suggesting the excavation extended to or below the water table or a perched water condition. The entire floor of the site was reportedly covered with refuse and then an intermediate cover was added to start a new lift. There was also an incinerator purchased with this property in the early 1950s. The Town of North Hempstead eventually built an additional incinerator in 1953. The incinerators burned most of the estimated 350-400 tons of garbage accepted at the landfill each day (EA Site Inspection and Appendixes 1.1-1 and 1.1-2). A total of five lifts brought the excavated site to grade in 1963, and this portion of the landfill was closed and replaced by the northern section (Appendix 1.1-1).

The northern plot of the Denton Avenue Landfill is approximately the same size as the southern fill area and was also originally used for sand and gravel mining. (Town officials believe Mr. DePasquale obtained the property from Colonial Sand and Stone Company (Appendix 1.1-2).) This excavation extended close to the water table as indicated by the presence of ponded water on the bottom of the original pit. Landfilling in this section began in 1963, and reached capacity in 1966 (Appendix 1.1-1). Following closure, a clayey fill material from excavation activity for extensions to the Northern State Parkway was used to cover 90 percent of this section of the landfill. In some areas, the cover was reported to be 4 ft thick (Appendixes 1.1-1 and 1.1-2).

After the final cover was applied to the northern landfill, methane gas began migrating into nearby homes (Appendix 1.1-2). In the early 1970s, several abatement techniques were initiated to alleviate the problems. Vents were installed in the affected homes and a trench was dug about 150 ft south of Hillside Avenue on the northern edge of the landfill and backfilled with crushed rock. In addition, vent pipes were sunk into the landfill mass (Appendixes 1.1-2 and 1.1-4). On 21 September 1976, representatives of the NYSDEC and the NCDOH collected gas samples in the landfill area as well as points outside the perimeter and found that the problem was still not in control. A hole dug in the ground at the venting trench caught fire after applying a lighted match to it, and continued to burn for at least 15-20 minutes. The fire continued to burn despite efforts to extinguish the flames and it was necessary for one of the Town's employees to obtain a sprinkler truck in order to eliminate the fire (Appendixes 1.1-4 and 1.1-5). As a result of their findings, the NYSDEC on 27 September 1976, called for corrective action of the problem along with a program of routine gas monitoring and surveillance. The Town of North Hempstead agreed to take gas readings on a weekly basis (Appendix 1.1-5).

In 1977, the U.S. EPA changed the air standards for the area and the incinerators at the Denton Avenue Landfill, still being used to burn raw garbage for another landfill, had to be shut down. In 1978, development of recreational and athletic facilities began. Several ball fields, a physical activity center, and a stadium were built over the southern landfill. About the same time, a senior citizens facility and organic gardens were built on the northern facility. Later that year, a golf driving range replaced the organic gardening facilites (Appendix 1.1-2). In September 1978, an inspection of this area by Chief of the Garden City Park Fire Department revealed stressed vegetation and scars of a fire where the ground had cracked (Appendix 1.1-6). A reinspection of the site in October revealed methane to be present in other portions of the site as well as the driving range. Readings were taken in the basement of the Police Boy's Club building excavation, and the presence of methane was confirmed. As a result, it was recommended that some type of venting, either external or internal be incorporated into the building plans. No action was deemed necessary in the area of the driving range (Appendix 1.1-7).

Events developing in Suffolk County and other communities during late 1979 and early 1980 created public health concerns over toxic gas emissions from landfills. As a result, a program of air monitoring at ten landfills in Nassau County commenced in June 1980. The Denton Avenue Landfill was included in the ten landfills surveyed. Sampling for total hydrocarbons (THC), methane, and vinyl chloride revealed only the presence of methane in the ground at the site. Samples taken downwind of the sampling points indicated that any methane escaping from the ground was quickly diluted by the ambient air (Appendix 1.1-8).

In 1981, Fred C. Hart Associates (FCH) filed an inspection report of the Denton Avenue Landfill with the U.S. EPA. The consultant concluded that the recharge basin between the two landfills and nearby wells should be sampled to identify any leachate contamination. FCH also recommended additional vinyl chloride surveying with an organic vapor analyzer (Appendix 1.1-9).

On 11 and 12 November 1982, five monitoring wells were installed reportedly downgradient of the Denton Avenue Landfill under the supervision of NCDOH. Ground water in the vicinity of the Denton Avenue Landfill was reportedly determined to flow from east to west and it was decided at the time that the wells should be installed downgradient (west) of the two portions of the landfill (Appendixes 1.1-1 and 1.1-10). Drilling was performed by Layne-New

York Company, Inc. and the NCDOH consultant was ERM-Northeast. Both the north and south landfill sites had two wells installed, 95 and 120 ft deep, on their western borders and a fifth well (100 ft deep) was installed approximately 800 ft west of the northern landfill on the property of the William Bowie School. During EA's 20 January 1986 site reconnaissance, an attempt was made to locate Wells DA-4 and DA-5 (reportedly located west of the southern portion of the site), however, the wells were not located. On 22 November and 3 December 1982, ground water was collected from the five monitoring wells by NCDOH personnel and analyzed by the NCDOH laboratory for U.S. EPA priority pollutants, an expanded list of heavy metals, and general water quality parameters.

As a result of the NCDOH ground-water sampling program in 1982, ERM-Northeast concluded that a plume of ground water contaminated primarily by iron and lead has migrated at least 800 ft downgradient of the north landfill site. ERM-Northeast recommended that: 1) the wells should be sampled regularly for at least a year to evaluate average annual and maximum plume concentrations; 2) the head relationships between the upper glacial and Magothy aquifers should be quantified; 3) the extent and permeability of the fill at the north site should be determined; and 4) both sites should be regarded with additions to the covers, if warranted, in order to decrease infiltration and leachate generation (Appendix 1.1-1).

Currently, the Denton Avenue Landfill property is the site of the North Hempstead recreational facility. The only problems encountered at the south landfill site are related to land settling. Methane gas has presented problems at the newer landfill (northern portion) but is no longer sampled. The Town Attorney has indicated that neither methane nor ground water is currently sampled at the site (Appendix 1.1-12).

4.2 SITE TOPOGRAPHY

The Denton Avenue Landfill is an inactive municipal landfill located at an elevation of approximately 100 ft above MSL. The site, situated on the west side of Denton Avenue in New Hyde Park, consists of two separate 27-acre rectangular plots separated by a large recharge basin (Appendix 1.1-1). The entire site is bounded on the north by Hillside Avenue, on the south by Evergreen Avenue, and on the west by Leonard Boulevard and Maple Drive (Appendix 1.2-1). Regional, as well as local slope, is less than 3 percent. The southern landfill is currently the site of a town recreational facility, and the northern portion of the landfill is an undeveloped field.

Prior to landfilling, the property was used for sand and gravel mining. Both portions of the landfill reportedly originated as gravel pits and were eventually filled to grade and covered (Appendix 1.1-1). As a result of hazardous methane gas conditions in the northern landfill, the Town of North Hempstead installed a trench along the northern edge of the landfill, approximately 150 ft south of Hillside Avenue. The trench was then backfilled with crushed rock. Along the western periphery and in other areas, vent pipes were sunk into the landfill (Appendixes 1.1-2 and 1.1-4).

Situated along the eastern edge of the site are the Boy's Club and Department of Public Work's (DPW) facilities built on the edge of or immediately adjacent to the northern and southern landfills, respectively. The DPW facility is located on the former site of the incinerator. Pioneer Mason Materials, a concrete plant, is situated between the Boy's Club and the DPW facilities. The nearest residence is approximately 0.14 mi to the west along Maple Drive. To the north of the site along the south side of Hillside Avenue are commercial establishments, while to the south of the entire site there is a school and an industrial area. The homes and businesses immediately surrounding the Denton Avenue Landfill are supplied by public water (Appendix 1.2-2). The nearest surface water is two golf course ponds located approximately 2 mi south of the site. Based on a 1980 survey performed by the NCDOH, surface water runoff from the site is expected to reach the large recharge basin that separates the northern and southern landfill areas (Appendix 1.2-3). This, along with the existence of other recharge basins within the immediate vicinity of the site, is expected to pre-clude site runoff from reaching the two ponds.

4.3 HYDROGEOLOGY

The Denton Avenue Landfill site is directly underlain by Pleistocene Age glacial outwash deposits, which are in turn underlain by the Cretaceous Age Magothy Formation, the Clay Member and Lloyd Sand Member of the Cretaceous Age Raritan Formation, and finally by Precambrian Age gneiss and schist bedrock (Appendix 1.3-1). Based upon the geologic logs available for Wells DA-1, DA-5, N17, and N3673, the Pleistocene outwash deposits in the vicinity of the landfill are estimated to be approximately 85-120 ft in thickness, and composed of stratified medium to coarse sand and gravel (Appendixes 1.1-1 and 1.3-2).

The Magothy Formation locally appears to be approximately 325 ft thick (Appendix 1.1-1). Of the five monitoring wells installed at the Denton Avenue Landfill site, only two reportedly penetrated the Magothy. Wells DA-1 and DA-5, however, only penetrated 5-10 ft of the formation (Appendix 1.1-1) and, thus, do not provide additional characterization. Regionally, the Magothy Formation generally "consists chiefly of fine micaceous sand, sandy clay, and clay. The colors are usually gray, white, pink, or red; lignite, pyrite, and iron oxide concretions are common throughout. Gravel occurs in a zone at the bottom and in lenses at somewhat higher altitudes" (Appendix 1.3-1).

The Clay member of the Raritan Formation is estimated to be approximately 130 ft in thickness. Generally, this unit "consists of about 100-200 ft of relatively impermeable solid and silty clay, usually dark gray and lignitic zones" (Appendix 1.3-1). The Lloyd Sand member of the Raritan Formation is estimated to be approximately 200 ft in thickness. This member is a stratified deposit of discontinuous layers of sand, gravel, sandy clay, silt, and clay (Appendix 1.3-1).

All freshwater supplies in Nassau County are derived from ground water. Swarenski (1963, Appendix 1.3-1) defines the "principal aquifer" as "that part of the Magothy Formation which occurs from about 50 ft below sea level downward to the top of the clay member of the Raritan Formation. In places, moreover, the aquifer includes Pleistocene deposits which blanket the Magothy or lie in channels cut into it." This indicates that the Pleistocene upper glacial aquifer and Magothy (principal) aquifer are hydraulically connected, and for the purpose of HRS, will be considered as a single hydrologic unit. Both the upper glacial (Pleistocene) deposits and the Magothy Formation have been developed by wells for public water supply (Appendixes 1.3-3 and 1.3-4) and for the purpose of HRS are designated as the aquifer of concern. Although the Lloyd Sand member of the Raritan Formation has been developed by two wells of the Manhasset-Lakeville Water District and one well of the Jamaica Water District, this aquifer is directly overlain by the thick extensive, confining (low permeability) Clay member of the Raritan Formation (Appendix 1.3-1). Additionally, each of these wells is only one or two of several which supply each of the two water districts. The remainder of the wells for each of the two districts are completed in the upper glacial and Magothy deposits (Appendixes 1.3-3 and 1.3-4). Therefore, the Lloyd Aquifer will not be considered further by the Phase I investigation.

Recharge to the upper glacial portion of the aquifer of concern is derived entirely from precipitation. Recharge to the Magothy portion and Lloyd aquifer is derived from the downward movement of water from each overlying aquifer. In general, recharge to the lower aquifers occurs near the center of Long Island, while discharge is to the ocean or Long Island Sound (Appendix 1.3-1). The average annual precipitation in the area is reported to be approximately 43 in., of which about 50 percent (22.5 in.) is estimated to infiltrate to the water table (Appendix 1.3-1). The remainder of the precipitation is returned to the atmosphere by evapotranspiration, except for runoff to streams.

Based upon four of the monitoring wells installed for the NCDOH at the Denton Avenue Landfill, depth to ground water in 1982 is estimated to be approximately 68-81 ft below grade, as compared to a suggested depth to water of 45 ft below grade reportedly observed in the base of the sand pit in the early 1950s.

Based upon the 7 December 1982 water level elevation in the same four wells, plus that measured in five nearby, previously existing, observation wells, ERM determined that local ground-water flow direction is toward the west and west-southwest at a calculated rate of 0.76 ft/day (Appendix 1.1-1). This compares well with the regional ground-water flow direction reported by Donaldson and Koszalka (Appendix 1.3-5). Within 3-mi of the site, the aquifer of concern has been developed by seven Manhasset-Lakeville Water District wells, two Port Washington Water District wells, five Albertson Water District wells, three Williston Park Water District wells, four Garden City Park Water District wells, four Mineola Village Water District wells, five Garden City Water District wells, ten Jamaica Water District wells, one Plainview Water District well, two Franklin Square Water District wells, and one West Hempstead-Hempstead Gardens Water District well. The area within 3 mi of the site is served by the eleven aforementioned water districts. Appendix 1.3-4 provides a list of the active public wells located within 3 mi of the site.

4.4 SITE CONTAMINATION

Waste Types and Quantities

The Denton Avenue Landfill operated from 1953 to 1966 under the Town of North Hempstead. No documentation exists with specific information regarding any disposal of hazardous materials at the site but a superintendent of the Town's Sanitation Department described the waste material in general as municipal refuse. The only industrial waste accepted was wood and cardboard (Appendix 1.1-1).

Ground Water

Ground water in the vicinity of the Denton Avenue Landfill was first sampled in November 1982 by NCDOH personnel and analyzed for U.S. EPA priority pollutants, an expanded list of heavy metals, and general water quality parameters. In a November 1982 sampling program, an elevated concentration of ammonia (11.0 mg/liter) was detected in monitoring well DA-1. All five wells sampled contained elevated concentrations of lead (0.05-0.62 mg/liter) and iron (21.0-75.0 mg/liter), all of which are above the New York State Class GA ground-water standards. Four of the five wells sampled contained elevated concentrations of manganese (0.05-62.0 mg/liter). No volatile organic compounds, PCBs or pesticides were detected. Various phthalates ranging in concentration from 1.0 to 22.0 ppb were found in ground water collected in wells DA-1, DA-2, and DA-3. Dimethylnaphthalene (76.0 ppb) was detected in well DA-4 (Appendixes 1.1-1 and 1.1-11). Although there was no concurrent sampling of background water quality, ERM selected five nearby previously existing observation wells for comparison of the above downgradient ground-water quality data with ambient conditions. Three of the five previously existing wells are screened in the glacial sediment similar to the five DA-series wells located downgradient. The existing quality data includes only standard water quality parameters (no organics) for various times between 1979 and 1982 (Appendix 1.1-1, Table 10-1); however, the results are relatively similar. The iron concentration reported for the ambient conditions (0.19-2.9 mg/liter) is considerably less than that reported for the DA-series wells (21-75 mg/liter) downgradient of the Denton Avenue Landfill. Because of the general consistency of the 1979-1982 quality data and that the ground-water flow rate is only about 0.76 ft/day, these data are currently considered representative of ambient conditions. Specifically, Well 8694 (located about 3,000 ft southeast of the site) was sampled in August 1982 (about 3 months prior to the DA-series wells). The iron concentration of the Well 8694 sample was less than 0.5 mg/liter compared with 21-75 mg/liter in samples from the DA-series wells. This is considered a significant (greater than 10 times) increase, and thus for HRS scoring confirms a release of contaminants to the ground water.

Surface Water

No data available.

Soil

No data available.

Air

No data available.

DENTON AVENUE LANDFILL
TOWN OF NORTH HEMPSTEAD, NASSAU COUNTY

The Denton Avenue Landfill site, located southwest of the intersection of Denton and Hillside Avenues in New Hyde Park, is an inactive landfill that operated from 1953 to 1966. The property, owned by the Town of North Hempstead, consists of two 27-acre rectangular plots separated by a large recharge basin. Both landfills were constructed in old sand pits excavated close to the water table. There is no documentation of hazardous waste disposal at the landfill and the superintendent of the Town's Sanitation Department has described the waste material, in general, as municipal refuse. The southernmost landfill was closed in 1963. Upon closure of the northern landfill in 1966, a clayey fill material was applied to 90 percent of the landfill. Soon thereafter, methane gas began migrating into nearby homes. In the early 1970s, vents were installed in the affected homes, a trench backfilled with crushed rock was installed on the northern edge of the landfill, and vent pipes were sunk into the landfill mass to alleviate the problem. The Town of North Hempstead agreed to monitor gas on a weekly basis, but methane gas continued to be a problem at the northern landfill throughout the 1970s. In 1980, air monitoring of several other contaminants revealed only the presence of methane in the ground. In 1982, five ground-water monitoring wells were installed downgradient of both landfills and sampling revealed elevated concentrations of ammonia, iron, dimethylnaphthalene, and several phthalates. For the purpose of HRS scoring, iron was used to confirm a release to ground water. The Nassau County Department of Health consultant, upon reviewing the analytical data, concluded that a plume of ground water contaminated by iron and lead has migrated at least 800 ft downgradient of the north landfill site. Currently, the Denton Avenue Landfill property is the site of the North Hempstead recreational facility. Neither methane gas nor ground water is currently sampled.

Ground Water Route Work Sheet					
Rating Factor	**Assigned Value (Circle One)**	**Multiplier**	**Score**	**Max. Score**	**Ref. (Section)**
1 Observed Release	0 45	1	45	45	3.1
If observed release is given a score of 45, proceed to line 4. If observed release is given a score of 0, proceed to line 2.					
2 Route Characteristics					3.2
Depth to Aquifer of Concern	0 1 2 3	2		6	
Net Precipitation	0 1 2 3	1		3	
Permeability of the Unsaturated Zone	0 1 2 3	1		3	
Physical State	0 1 2 3	1		3	
	Total Route Characteristics Score			15	
3 Containment	0 1 2 3	1		3	3.3
4 Waste Characteristics					3.4
Toxicity/Persistence	0 3 6 9 12 15 18	1	18	18	
Hazardous Waste Quantity	0 1 2 3 4 5 6 7 8	1	1	8	
	Total Waste Characteristics Score		19	26	
5 Targets					3.5
Ground Water Use	0 1 2 3	3	6	9	
Distance to Nearest Well/Population Served	0 4 6 8 10 12 16 18 20 24 30 32 35 40	1	35	40	
	Total Targets Score		41	49	
6 If line 1 is 45, multiply 1 x 4 x 5 If line 1 is 0, multiply 2 x 3 x 4 x 5			35,055	57,330	
7 Divide line 6 by 57,330 and multiply by 100			S_{gw} = 61.15		

FIGURE 2
GROUND WATER ROUTE WORK SHEET

Surface Water Route Work Sheet					
Rating Factor	Assigned Value (Circle One)	Multi-plier	Score	Max Score	Ref. (Section)
1 Observed Release	0 45	1	0	45	4.1
If observed release is given a value of 45, proceed to line 4. If observed release is given a value of 0, proceed to line 2.					
2 Route Characteristics					4.2
Facility Slope and Intervening Terrain	0 1 2 3	1	0	3	
1-yr. 24-hr. Rainfall	0 1 2 3	1	2	3	
Distance to Nearest Surface Water	0 1 2 3	2	0	6	
Physical State	0 1 2 3	1	0	3	
Total Route Characteristics Score			2	15	
3 Containment	0 1 2 3	1	0	3	4.3
4 Waste Characteristics					4.4
Toxicity/Persistence	0 3 6 9 12 15 18	1	0	18	
Hazardous Waste Quantity	0 1 2 3 4 5 6 7 8	1	0	8	
Total Waste Characteristics Score			0	26	
5 Targets					4.5
Surface Water Use	0 1 2 3	3	6	9	
Distance to a Sensitive Environment	0 1 2 3	2	0	6	
Population Served/Distance to Water Intake Downstream	0 4 6 8 10 12 16 18 20 24 30 32 35 40	1	0	40	
Total Targets Score			6	55	
6 If line 1 is 45, multiply 1 x 4 x 5. If line 1 is 0, multiply 2 x 3 x 4 x 5			0	64,350	
7 Divide line 6 by 64,350 and multiply by 100	S_{sw} = 0				

FIGURE 7
SURFACE WATER ROUTE WORK SHEET

Air Route Work Sheet					
Rating Factor	Assigned Value (Circle One)	Multiplier	Score	Max Score	Ref. (Section)
1 Observed Release	0 45	1	0	45	5.1
Date and Location:					
Sampling Protocol:					
If line 1 is 0, the S_a = 0. Enter on line 5. If line 1 is 45, then proceed to line 2.					
2 Waste Characteristics					5.2
Reactivity and Incompatibility	0 1 2 3	1		3	
Toxicity	0 1 2 3	3		9	
Hazardous Waste Quantity	0 1 2 3 4 5 6 7 8	1		8	
	Total Waste Characteristics Score			20	
3 Targets					5.3
Population Within 4-Mile Radius	0 9 12 15 18 21 24 27 30	1		30	
Distance to Sensitive Environment	0 1 2 3	2		6	
Land Use	0 1 2 3	1		3	
	Total Targets Score			39	
4 Multiply 1 x 2 x 3				35,100	
5 Divide line 4 by 35,100 and multiply by 100		S_a = 0			

FIGURE 9
AIR ROUTE WORK SHEET

	S	S^2
Groundwater Route Score (S_{gw})	61.15	3,739.32
Surface Water Route Score (S_{sw})	0	0
Air Route Score (S_a)	0	0
$S_{gw}^2 + S_{sw}^2 + S_a^2$		3,739.32
$\sqrt{S_{gw}^2 + S_{sw}^2 + S_a^2}$		61.15
$\sqrt{S_{gw}^2 + S_{sw}^2 + S_a^2} / 1.73 = S_M =$		35.35

FIGURE 10
WORKSHEET FOR COMPUTING S_M

Fire and Explosion Work Sheet					
Rating Factor	**Assigned Value (Circle One)**	**Multi-plier**	**Score**	**Max Score**	**Ref. (Section)**
1 Containment	1 3	1		3	7.1
2 Waste Characteristics					7.2
Direct Evidence	0 3	1		3	
Ignitability	0 1 2 3	1		3	
Reactivity	0 1 2 3	1		3	
Incompatibility	0 1 2 3	1		3	
Hazardous Waste Quantity	0 1 2 3 4 5 6 7 8	1		8	
	Total Waste Characteristics Score			20	
3 Targets					7.3
Distance to Nearest Population	0 1 2 3 4 5	1		5	
Distance to Nearest Building	0 1 2 3	1		3	
Distance to Sensitive Environment	0 1 2 3	1		3	
Land Use	0 1 2 3	1		3	
Population Within 2-Mile Radius	0 1 2 3 4 5	1		5	
Buildings Within 2-Mile Radius	0 1 2 3 4 5	1		5	
	Total Targets Score			24	
4 Multiply 1 x 2 x 3				1,440	
5 Divide line 4 by 1,440 and multiply by 100	S_{FE} = N/A				

FIGURE 11
FIRE AND EXPLOSION WORK SHEET

Direct Contact Work Sheet					
Rating Factor	Assigned Value (Circle One)	Multiplier	Score	Max Score	Ref. (Section)
1 Observed Incident	0 45	1	0	45	8.1
If line 1 is 45, proceed to line 4 If line 1 is 0, proceed to line 2					
2 Accessibility	0 1 2 3	1	3	3	8.2
3 Containment	0 15	1	0	15	8.3
4 Waste Characteristics Toxicity	0 1 2 3	5	0	15	8.4
5 Targets					8.5
Population Within a 1-Mile Radius	0 1 2 3 4 5	4	20	20	
Distance to a Critical Habitat	0 1 2 3	4	0	12	
Total Targets Score			20	32	
6 If line 1 is 45 multiply 1 x 4 x 5 If line 1 is 0, multiply 2 x 3 x 4 x 5			0	21,600	
7 Divide line 6 by 21,600 and multiply by 100	S_{DC} = 0				

FIGURE 12
DIRECT CONTACT WORK SHEET

DOCUMENTATION RECORDS
FOR
HAZARD RANKING SYSTEM

INSTRUCTIONS: As briefly as possible, summarize the information you used to assign the score for each factor (e.g., "Waste quantity = 4,230 drums plus 800 cubic yards of sludges"). The source of information should be provided for each entry and should be a bibliographic-type reference. Include the location of the document.

FACILITY NAME: Denton Avenue Landfill

LOCATION: Town of North Hempstead, Nassau County

DATE SCORED: 17 February 1987

PERSON SCORING: EA Science and Technology

PRIMARY SOURCES(S) OF INFORMATION (e.g., EPA region, state, FIT, etc.)

Nassau County Department of Health
New York State Department of Environmental Conservation
EA Site Inspection, 20 January 1986

FACTORS NOT SCORED DUE TO INSUFFICIENT INFORMATION:

COMMENTS OR QUALIFICATIONS:

Hazardous waste disposal at the site has not been documented.

The Migration Score (S_M) is based on a significant increase in the concentration of iron in ground water downgradient of the site compared to ambient conditions established at a well located approximately 3,000 ft south-southeast of the site which was sampled approximately 3 months prior to the downgradient wells (Chapter 4.4).

No viable overland route for surface water exists.

GROUND WATER ROUTE

1 OBSERVED RELEASE

Contaminants detected (5 maximum):

Iron.

Reference: 1.

Assigned value = 45

Reference: 2.

Rationale for attributing the contaminants to the facility:

The concentration of iron (21-75 mg/liter) in the November 1982 ground water downgradient of the site (DA-series wells) is considerably higher (>10 times) than ambient conditions (<0.5 mg/liter) established at Well 8694, which is located approximately 3,000 ft south-southeast of the site. Although the upgradient well was sampled approximately 3 months prior to the DA-series wells, the data are considered adequate for a preliminary S_{GW} because the wells are completed at similar depths, and the calculated ground-water flow rate is only about 0.76 ft/day.

***

2 ROUTE CHARACTERISTICS

Depth to Aquifer of Concern

Name/description of aquifer(s) of concern:

Depth(s) from the ground surface to the highest seasonal level of the saturated zone (water table[s]) of the aquifer of concern:

Depth from the ground surface to the lowest point of waste disposal/storage:

Depth to aquifer of concern:

Net Precipitation

Mean annual or seasonal precipitation (list months for seasonal):

Mean annual lake or seasonal evaporation (list months for seasonal):

Net precipitation (subtract the above figures):

Permeability of Unsaturated Zone

Soil type in unsaturated zone:

Permeability associated with soil type:

Physical State

Physical state of substances at time of disposal (or at present time for generated gases):

***

3 CONTAINMENT

Containment

Method(s) of waste or leachate containment evaluated:

Method with highest score:

***

4 WASTE CHARACTERISTICS

Toxicity and Persistence

Compound(s) evaluated:

Iron. Reference: 1.

Compound with highest score:

Iron = 18.

Reference: 2 and 25.

Hazardous Waste Quantity

Total quantity of hazardous substances at the facility, excluding those with a containment score of 0 (Give a reasonable estimate even if quantity is above maximum):

No analytical data identifying waste characteristics of material disposed of at the site (Chapter 3).

Basis of estimating and/or computing waste quantity:

Minimum quantity assumed.

Assigned value = 1.

Reference: 2.

***

5 TARGETS

Ground Water Use

Use(s) of aquifer(s) of concern within a 3-mile radius of the facility:

Drinking water with municipal water from alternate sources presently available.

References: 3-6.

Assigned value = 2.

Reference: 2.

Distance to Nearest Well

Location of nearest well drawing from aquifer of concern or occupied building not served by a public water supply:

Public supply well serving the Garden City Park Water District located along Denton Avenue, east of the site.

Reference: 3.

Distance to above well or building:

0.5 mi. Measured from the farthest border of the landfill.

Reference: 3.

Assigned value = 3.

Reference: 2.

Population Served by Ground Water Wells Within a 3-Mile Radius

Identified water-supply well(s) drawing from aquifer(s) of concern within a 3-mile radius and populations served by each:

Community Supplies	Population Served
Garden City Water District	23,000
Franklin Square Water District	21,000
Manhasset-Lakeville Water District	46,048
Jamaica Water District	129,000
Albertson Water District	13,000
Mineola Village Water District	21,000
Garden City Park Water District	22,600
Port Washington Water District	38,000
West Hempstead - Hempstead Garden Water District	28,000
Williston Park Village Water District	8,216
Plainview Water District	40,000
Total Population Served	389,864

References: 5-15.

Computation of land area irrigated by supply well(s) drawing from aquifer(s) of concern within a 3-mile radius, and conversion to population (1.5 people per acre):

No agricultural land is reported within a 3-mi radius of the site.

Reference: 16.

Total population served by ground water within a 3-mile radius:

389,864.

Assigned value = 5. Combined assigned value = 35.

Reference: 2.

SURFACE WATER ROUTE

1 OBSERVED RELEASE

Contaminants detected in surface water at the facility or downhill from it (5 maximum):

No data available (Chapter 3).

Assigned value = 0.

Reference: 2.

Rationale for attributing the contaminants to the facility:

***

2 ROUTE CHARACTERISTICS

Facility Slope and Intervening Terrain

Average slope of facility in percent:

Average slope = <3 percent. Estimated using Suunto clinometer.

Reference: 17.

Name/description of nearest downslope surface water:

Two ponds located in a golf course/country club facility.

Reference: 18.

Average slope of terrain between facility and above-cited surface water body in percent:

<3 percent (estimated from topographic maps). However, runoff from the site is expected to flow directly or via storm drains to the large recharge basin

that separates the northern and southern fill areas. In addition, other recharge basins are located in the vicinity of the site.

References: 18 and 19.

Is the facility located either totally or partially in surface water?

No.

Reference: 17.

Is the facility completely surrounded by areas of higher elevation?

No.

References: 17 and 18.

Assigned value = 0.

Reference: 2.

1-Year, 24-Hour Rainfall in Inches

2.5 in.

Assigned value = 2.

Reference: 20.

Distance to Nearest Downslope Surface Water

2 mi. However, surface runoff from the site is expected to enter the large recharge basin which separates the northern and southern fill areas either directly or via storm drains. In addition, other recharge basins are located in the vicinity of the site.

References: 18 and 19.

Assigned value = 0.

Reference: 2.

Physical State of Waste

Hazardous waste disposal has not been documented (Chapter 3).

Assigned value = 0.

Reference: 2.

***

3 CONTAINMENT

Containment

Method(s) of waste or leachate containment evaluated:

Landfill; intervening terrain precludes runoff to surface water.

Method with highest score:

The northern landfill is covered with a clayey material up to 4 ft in thickness in some areas. The southern landfill is covered, but the depth of cover is unknown. Surface water runoff from the site is expected to enter the large recharge basin, which separates the northern and southern fill areas, either directly or via storm drains. In addition, other recharge basins are located in the vicinity of the site.

References: 1, 17-19.

Assigned value = 0.

Reference: 2.

***

4 WASTE CHARACTERISTICS

Toxicity and Persistence

Compound(s) evaluated

Containment score is zero. Therefore, waste characteristics are not evaluated.

Assigned value = 0.

Reference: 2.

Compound with highest score:

Hazardous Waste Quantity

Total quantity of hazardous substances at the facility, excluding those with a containment score of 0 (Give a reasonable estimate even if quantity is above maximum):

Basis of estimating and/or computing waste quantity:

***

5 TARGETS

Surface Water Use

Use(s) of surface water within 3 miles downstream of the hazardous substance:

There are two ponds located in a golf course/country club facility located approximately 2 mi downslope of the facility. Use is assumed to be recreational.

Reference: 18.

Assigned value = 2.

Reference: 2.

Is there tidal influence?

No.

Reference: 18.

Distance to a Sensitive Environment

Distance to 5-acre (minimum) coastal wetland, if 2 miles or less:

None.

Reference: 18.

Distance to 5-acre (minimum) freshwater wetland, if 1 mile or less:

None.

Reference: 18.

Distance to critical habitat of an endangered species or national wildlife refuge, if 1 mile or less:

None.

Reference: 21.

Assigned value = 0.

Reference: 2.

Population Served by Surface Water

Location(s) of water supply intake(s) within 3 miles (free-flowing bodies) or 1 mile (static waterbodies) downstream of the hazardous substance and population served by each intake:

None.

Reference: 22.

Computation of land area irrigated by above-cited intake(s) and conversion to population (1.5 people per acre).

None. There is no reported agricultural land within 3 mi of the landfill.

Reference: 16.

Total population served:

Zero.

References: 16 and 22.

Assigned value = 0.

Reference: 2.

Name/description of nearest of above waterbodies:

Distance to above-cited intakes, measured in stream miles.

AIR ROUTE

EA has researched all agency files and has found no data indicating a release to air (Chapter 3).

Assigned value = 0.

Reference: 2.

1 OBSERVED RELEASE

Contaminants detected:

Date and location of detection of contaminants

Methods used to detect the contaminants:

Rationale for attributing the contaminants to the site:

***

2 WASTE CHARACTERISTICS

Reactivity and Incompatibility

Most reactive compound:

Most incompatible pair of compounds:

Toxicity

Most toxic compound:

Hazardous Waste Quantity

Total quantity of hazardous waste:

Basis of estimating and/or computing waste quantity:

***

3 TARGETS

Population Within 4-Mile Radius

Circle radius used, give population, and indicate how determined:

0 to 4 mi 0 to 1 mi 0 to 1/2 mi 0 to 1/4 mi

Distance to a Sensitive Environment

Distance to 5-acre (minimum) coastal wetland, if 2 miles or less:

Distance to 5-acre (minimum) freshwater wetland, if 1 mile or less:

Distance to critical habitat of an endangered species, if 1 mile or less:

Land Use

Distance to commercial/industrial area, if 1 mile or less:

Distance to national or state park, forest, or wildlife reserve if 2 miles or less:

Distance to residential area, if 2 miles or less:

Distance to agricultural land in production within past 5 years, if 1 mile or less:

Distance to prime agricultural land in production within past 5 years, if 2 miles or less:

Is a historic or landmark site (National Register or Historic Places and National Natural Landmarks) within the view of the site?

FIRE AND EXPLOSION

The local fire marshal has not certified that the site presents a signficant fire or explosion threat.

Reference: 23.

1 CONTAINMENT

Hazardous substances present:

Type of containment, if applicable:

***

2 WASTE CHARACTERISTICS

Direct Evidence

Type of instrument and measurements:

Ignitability

Compound used:

Reactivity

Most reactive compound:

Incompatibility

Most incompatible pair of compounds:

Hazardous Waste Quantity

Total quantity of hazardous substances at the facility:

Basis of estimating and/or computing waste quantity:

***

3 TARGETS

Distance to Nearest Population

Distance to Nearest Building

Distance to Sensitive Environment

Distance to wetlands:

Distance to critical habitat:

Land Use

Distance to commercial/industrial area, if 1 mile or less:

Distance to national or state park, forest, or wildlife reserve, if 2 miles or less:

Distance to residential area, if 2 miles or less:

Distance to agricultural land in production within past 5 years, if 1 mile or less:

Distance to prime agricultural land in production within past 5 years, if 2 miles or less:

Is a historic or landmark site (National Register or Historic Places and National Natural Landmarks) within the view of the site?

Population Within 2-Mile Radius

Buildings Within 2-Mile Radius

DIRECT CONTACT

1 OBSERVED INCIDENT

Date, location, and pertinent details of incident:

None reported (Chapter 3).

***

2 ACCESSIBILITY

Describe type of barrier(s):

Vehicular and pedestrial access is completely unrestricted.

Reference: 17.

Assigned value = 0.

Reference: 2.

***

3 CONTAINMENT

Type of containment, if applicable:

The landfill is covered.

Reference: 17.

Assigned value = 0.

Reference: 2.

***

4 WASTE CHARACTERISTICS

Toxicity

Compounds evaluated:

Hazardous waste disposal has not been documented (Chapter 3).

Assigned value = 0.

Reference: 2.

Compound with highest score:

***

5 TARGETS

Population Within 1-Mile Radius

22,199. Estimated 50 percent of the population of North New Hyde Park (14,596), 95 percent of Garden City Park (7,752), 20 percent of Herricks (7,811), 5 percent of Mineola (20,200), 5 percent of Garden City (22,895), and 40 percent of New Hyde Park (9,551).

Reference: 24.

Assigned value = 5.

Reference: 2.

Distance to Critical Habitat (of Endangered Species)

None within 1 mi.

Reference: 21.

Assigned value = 0.

Reference: 2.

6. ASSESSMENT OF DATA ADEQUACY AND RECOMMENDATIONS

6.1 ADEQUACY OF EXISTING DATA

The data are adequate to confirm a release of iron from the Denton Avenue Landfill to the ground water, and to prepare an HRS score for the site. The HRS scores are as follows: Migration Score (S_M) = 35.55; and the Direct Contact Score (S_{DC}) = 0.

The Migration Score (S_M) is based on a significant increase in the concentration of iron in the November 1982 ground water downgradient (21-75 mg/liter) of the site (DA-series wells) compared to ambient (<0.5 mg/liter) conditions established at Well 8694, which is located approximately 3,000 ft south-southeast of the site and was sampled approximately 3 months prior to the DA-series wells. Quality data from other upgradient/ambient wells were also considered (Section 4.4). Although, the upgradient and downgradient samples were not collected on the same date, the data are considered adequate for a Ground-water Score (S_{GW}), because the wells are completed at similar depths, and the calculated ground-water flow rate is only about 0.76 ft/day. No volatile organic, PCB, or pesticide compounds were detected in the November 1982 ground-water samples collected downgradient of the site. However, trace amounts of some phthalates, haloethers, and dimethylnaphthalene were detected in the downgradient samples. The upgradient ambient sample was not analyzed for organic compounds.

For the purpose of HRS scoring, a "significant" increase in the detected concentration of a contaminant (as related to this site) is defined as follows:

1. For a single analytical parameter not detected upgradient of the site, but detected downgradient of a site, a "significant" downgradient increase would be at least 3 times above the detection limit of the upgradient sample, and/or

2. For a single analytical parameter detected both upgradient and downgradient of the site, a "significant" downgradient increase would be at least 10 times above the concentrations detected upgradient.

Although there are no data available regarding the quality of surface water, there is no apparent viable route between the site and the nearest surface waterbody within 3 mi of the site.

6.2 RECOMMENDATIONS

Because a release of iron to ground water has been confirmed, the next step would be to evaluate the full character and the horizontal and vertical extent of the contamination. This is beyond the scope of a Phase II study; and therefore, performance of a Phase II study is not recommended for this site. However, it would be appropriate to install a well east of the site to a depth of about 100 ft below grade, and then to collect and analyse another complete suite of samples (DA-series and the new well) for analysis of the Hazardous Substance List of organic compounds and inorganic parameters to provide guidance for future studies.

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REFERENCE NO. 6

02-8902-06-SI
REV. NO. 0

FINAL DRAFT
SITE INSPECTION REPORT
DENTON AVENUE LANDFILL
NEW HYDE PARK, NEW YORK

PREPARED UNDER
TECHNICAL DIRECTIVE DOCUMENT NOS. 02-8902-06
CONTRACT NO. 68-01-7346

FOR THE

ENVIRONMENTAL SERVICES DIVISION
U.S. ENVIRONMENTAL PROTECTION AGENCY

SEPTEMBER 20, 1989

NUS CORPORATION
SUPERFUND DIVISION

SUBMITTED BY:

Diane Trube
DIANE TRUBE
PROJECT MANAGER

Brian Dietz
BRIAN DIETZ
SITE MANAGER

REVIEWED/APPROVED BY:

RONALD M. NAMAN
FIT OFFICE MANAGER

SITE NAME:	Denton Avenue Landfill	**EPA ID NO.:**	NYD981186919
ADDRESS:	Denton & Hillside Avenues New Hyde Park, Nassau County, New York	**LATITUDE:**	40° 45' 20" N
		LONGITUDE:	73° 42' 20" W
		Block Nos.:	211-14
		Lot Nos.:	673, 679

1.0 SITE SUMMARY

The Denton Avenue Landfill is an inactive landfill located on 54 acres in New Hyde Park, Nassau County, New York. The area surrounding the site is characterized by a combination of residential, commercial, and light-industrial properties The site is bordered by Hillside Avenue on the north, Denton Avenue on the east, Evergreen Avenue on the south, and Leonard Boulevard and Maple Drive on the west. Several small businesses adjoin the site along its northern border. The site property consists of a northern landfill and a southern landfill which are separated by a county-owned recharge basin. Waste disposal allegedly took place at both of the landfills, and encompassed an area of 54 acres. According to the available information, the recharge basin was never used for waste disposal; therefore, it is not considered to be part of the site. In the time since the site's closure, some of the original property has been developed for other uses. At the present time, the northern landfill consists of an undeveloped lot and a Police Boy's Club. The southern landfill currently consists of a large municipal park and recreational center. Approximately 211,000 people reside within 3 miles of the site. The nearest homes are located approximately 60 ft west of the area of waste disposal. The Denton Avenue Landfill is currently owned by the Town of North Hempstead.

While in operation, the Denton Avenue Landfill allegedly accepted 350 to 400 tons of municipal refuse per day. A large portion of this material was allegedly burned in two on-site incinerators prior to its disposal. Available information indicates that raw garbage was also disposed of at the site. It is unknown if the site ever accepted hazardous waste.

Operations began at the southern landfill in 1953 and continued until 1963. Prior to its use as a landfill, this 27-acre parcel had been used as a sandpit by the Flatlands Sand and Gravel Company. In converting the property into a municipal landfill, the entire site was excavated to depth of 45 ft below grade. Waste disposal took place in this excavated area. In 1963, the southern landfill was brought to grade, and was subsequently closed and covered. Waste disposal activities were then shifted to the northern landfill. Prior to its use as a landfill, the 27-acre northern parcel had been used by the Colonial Sand and Gravel Company for sand and gravel mining. It is believed that the northern parcel was excavated to a depth of approximately 40 ft. The northern landfill allegedly accepted raw garbage and incinerator ash from 1963 until 1966. From 1966 until 1974, this landfill only accepted incinerator ash. In 1974, a cover of clayey fill material was applied to approximately 90 percent of the northern landfill. This cover was reportedly 3 ft to 4 ft in thickness. A short time after this cover was applied, methane began migrating from the landfill into nearby homes. In an effort to combat this problem, vents were installed in the affected homes. In addition, 40 vent pipes and a venting trench were installed at the northern landfill.

On September 21, 1976, officials from the Nassau County Department of Health (NCDOH), the New York State Department of Environmental Conservation (NYSDEC), and the Town of North Hempstead (TNH) visited the northern landfill. The purpose of this visit was to determine if the on-site vent pipes and venting trench were successfully controlling the levels of methane at the landfill. To test for the presence of methane, a small hole was dug in the venting trench and a lighted match was applied to it. A portion of the venting trench subsequently caught fire and a sprinkler truck was required to extinguish the flames. As a result of this incident, NYSDEC requested TNH to take corrective measures at the site, and to institute a program of routine gas monitoring and surveillance. At about the same time, the town informed NYSDEC that they would be taking weekly gas readings at the site.

In 1977, the two on-site incinerators were forced to shut down due to changes in the federal air standards for this area. Since 1974, the incinerators had been burning raw garbage for another landfill. Incinerator ash from this process was stored overnight at the Denton Avenue Landfill, and transported to the other landfill for disposal.

In 1977, TNH excavated a portion of the southern landfill for the construction of an indoor swimming pool. The following year, the town began developing the southern landfill into a municipal park and recreation center. Several baseball fields, a stadium, tennis courts, and a physical activities center were constructed as part of this project. At the same time, a Police Boy's Club and an organic garden were built on the northern landfill. The organic garden was replaced by a golf driving range a short time later.

In September 1978, NCDOH received a complaint from the Chief of the Garden City Park Fire Department regarding the occurrence of methane fires at the northern landfill. A subsequent inspection by NCDOH revealed the presence of stressed vegetation and a burned and cracked area of ground. A reinspection of the site on October 3, 1978 revealed the presence of elevated levels of methane (i.e., exceeding the lower explosive limit) at a crack in the ground and in the excavation for the Police Boy's Club building. As a result of this inspection, it was recommended that some form of venting system be incorporated into the building plans of the Police Boy's Club. No action was deemed necessary to stop the flow of methane from the area of cracked ground.

From June 1980 to October 1980, NCDOH conducted a program of air monitoring at 10 landfills in Nassau County. The purpose of this study was to determine the extent of vinyl chloride emissions from county's active and inactive landfills. On July 2, 1980, NCDOH collected 10 air samples from the northern landfill as part of this study. Analyses of these samples did not reveal the presence of vinyl chloride at the site.

In November 1980, representatives from Fred C. Hart Associates, Inc. (FCH) conducted an inspection of the site. In a 10-page report that was submitted to U.S. EPA in January 1981, FCH recommended that samples be collected from the "on-site" recharge basin and from nearby wells. These samples were to be used to determine the potential for leachate to migrate from the site. In addition, FCH suggested that the site be rescreened for the presence of vinyl chloride, using an organic vapor analyzer.

The Denton Avenue Landfill is unlined and there is concern as to the impact that the site may have made on local groundwater. In October 1981, NCDOH requested its consultant, ERM-Northeast, to conduct a groundwater investigation at the Denton Avenue Landfill. As part of this investigation, in November 1982, five monitoring wells were installed downgradient of the site. Drilling was performed by Layne New York Company, Inc. under the supervision of NCDOH. Two of the wells (DA-1 and DA-2) were installed on the western edge of the northern landfill. These wells have become overgrown, and NCDOH personnel could not locate them during the FIT site reconnaissance on June 6, 1989. Another two wells (DA-4 and DA-5) were installed between the western edge of the southern landfill and Leonard Boulevard. The fifth well (DA-3) was installed approximately 800 ft west of the northern landfill on the property of the William Bowie School. Samples collected from these wells by NCDOH on November 22, 1982 and December 3, 1982 revealed the presence of metals at concentrations that exceeded federal drinking water standards, a phenol, phthalates, and trace amounts of halo-ethers. As a result of these findings, ERM-Northeast concluded that a plume of groundwater, contaminated primarily by iron and lead, had migrated at least 800 ft downgradient from the northern landfill. In addition, ERM-Northeast estimated that the Denton Avenue Landfill was generating leachate at the rate of approximately 13,196,000 gallons per year. In a report to NCDOH, ERM-Northeast recommended the following: (1) annual sampling of the monitoring wells to determine maximum, and average annual, plume concentrations, (2) the installation of additional monitoring wells at the site to help quantify the head relationship between the Upper Glacial and Magothy Aquifers, and (3) minor remedial measures that would further reduce the generation of leachate at the northern and southern landfills.

Based on the findings of the previous site studies, U.S. EPA requested NUS Corporation Region 2 FIT to conduct a site inspection at the Denton Avenue Landfill site. On June 14 and 15, 1989, NUS collected six groundwater samples, nine soil samples, two surface water samples, and two sediment samples (which included the collection of one environmental duplicate for each matrix sampled) to characterize the site. The groundwater samples were used to determine the potential for groundwater contamination and its migration from the site. The soil samples, sediment samples, and surface water samples were used to determine the potential for soil contamination and its migration to an adjacent recharge basin. The results of the groundwater sampling indicate the presence of metals at concentrations that exceed federal drinking water standards. The soil sampling results indicate the presence of metals, semivolatile compounds (SVOCs), pesticides, and polychlorinated biphenyls (PCBs). The sediment sampling results indicate the presence of metals and a PCB. The results of the surface water sampling indicate the presence of metals at concentrations that exceed federal drinking water standards.

Ref. Nos. 1, 2, 17

2.0 SITE INSPECTION NARRATIVE

2.1 EXISTING ANALYTICAL DATA

In September and October 1976, NCDOH collected gas samples from the site and at several locations along Leonard Boulevard. These samples were to be used in evaluating the effectiveness of the on-site venting system. The samples were collected from the ground and were analyzed for the amount of methane gas they contained. The nature of the samples (i e., air or soil), methods of sample analysis, and quality assurance are unknown. Analyses of the samples revealed the presence of potentially hazardous levels (i.e., concentrations exceeding the lower explosive limit) of methane at three locations on the northern landfill. The highest level of methane was detected in the venting trench located along the northern border of the site.

On July 2, 1980, NCDOH collected 10 air samples (including one field blank) from the northern landfill. The samples were forwarded to the NCDOH Division of Laboratories for analysis. Gas chromatography was used to analyze the samples for the presence of vinyl chloride Vinyl chloride was not detected in any of the samples.

On November 22, 1982, NCDOH collected groundwater samples from the five downgradient monitoring wells that are located west of the site. The samples were forwarded to a NCDOH laboratory for analysis. The samples were analyzed for EPA priority pollutants, an expanded list of heavy metals, and general water quality parameters. The methods of sample analysis are unknown. The methods of quality assurance are unknown; however, dedicated sampling equipment was used. Analysis of the groundwater samples revealed the presence of metals at concentrations that exceeded federal drinking water standards, phthalates, and halo-ethers. To determine the impact of the site on the local groundwater, these results were compared to limited preexisting data from 1979-1982 from five "background" wells located 3,000 ft to 4,000 ft from the site. (The locations of these wells are presented in reference No. 13). This comparison indicated the presence of elevated levels of iron and ammonia in the downgradient monitoring wells. The sampling results are summarized in Table 1 below:

TABLE 1. RESULTS OF GROUNDWATER SAMPLING CONDUCTED ON NOVEMBER 22, 1982

Compounds Present	Highest Concentration in Downgradient Monitoring Wells	Sample Location	Concentration Range Detected in "Background" Wells
Ammonia	11	MW-DA1	< 0.01 - 0.45
Iron*	61	MW-DA1	0.19 - 2.9
Manganese*	1.54	MW-DA2	NDA
Magnesium*	8.4	MW-DA1	"
Cadmium	0.006	MW-DA3	"
Chromium*	0.09	MW-DA4	"
Copper	0.08	MW-DA4	"
Lead*	0.62	MW-DA2	"
Zinc	0.53	MW-DA2	"
Dimethylnaphthalene	76	MW-DA4	"
p-Chloro-m-cresol	3	MW-DA4	"
Diethyl phthalate	10	MW-DA1	"
Di-n-butyl phthalate	22	MW-DA3	"
Butylbenzyl phthalate	6	MW-DA3	"
bis(2-ethylhexyl) phthalate	19	MW-DA3	"
Di-n-octyl phthalate	11	MW-DA3	"
4-Chlorophenyl phenyl ether	6	NW-DA4, MW-DA5	"
4-Bromophenyl phenyl ether	4	MW-DA2	"

NDA - Indicates no data available.

Note: All metals are expressed in units of mg/L, the remainder of the sample results are expressed in ug/L.

* - Indicates compound was detected at a concentration that exceeds Federal Drinking Water Standards.

On December 3, 1982, NCDOH collected a second set of groundwater samples from the downgradient monitoring wells. The wells were sampled using the same methods that were used on November 22, 1982. Sample analysis was conducted by a NCDOH laboratory. The samples were analyzed for EPA priority pollutants, an expanded list of heavy metals and general water quality parameters. The methods of sample analysis and quality assurance are unknown. Analysis of the groundwater samples revealed the presence of metals at concentrations that exceeded federal drinking water standards. Comparison of the sample results with the five background wells indicated the presence of elevated levels of iron and ammonia in the downgradient monitoring wells The sampling results are summarized in Table 2 below:

TABLE 2. RESULTS OF GROUNDWATER SAMPLING CONDUCTED ON DECEMBER 3, 1982

Compounds Present	Highest Concentration in Downgradient Monitoring Wells	Sample Location	Concentration Range Detected in "Background" Wells
Ammonia	100	MW-DA1	<0.01 - 0.45
Iron*	75	MW-DA1	0.19 - 2.9
Manganese*	1.93	MW-DA2	NDA
Cadmium	0.17	MW-DA2	"
Chromium*	0.05	MW-DA1, MW-DA2, MW-DA5	"
Copper	0.10	MW-DA2, MW-DA4	"
Lead*	0.30	MW-DA2	"
Magnesium	7.7	MW-DA1	"

NDA - Indicates no data available.

Note: All metals are expressed in units of mg/L.

* - Indicates compound was detected at a concentration that exceeds Federal Drinking Water Standards.

Ref. No. 1

2.2 WASTE SOURCE DESCRIPTION

While in operation, the Denton Avenue Landfill accepted approximately 350 tons to 400 tons of municipal refuse per day. A large portion of this waste was allegedly burned in two on-site incinerators, and deposited as ash. In addition, the site also accepted raw garbage. It is unknown if the site ever accepted hazardous waste. Waste disposal took place in a southern landfill and a northern landfill. The southern landfill operated from 1953 to 1963; it encompasses 27 acres and extends to a depth of 45 ft below grade. The northern landfill operated from 1963 to 1974; it encompasses 27 acres and extends to a depth of 40 ft below grade. As waste was disposed of at the site, it was distributed evenly across the bottom of the landfill and covered with an intermediate layer of fill. After application of this intermediate cover, a new layer of waste was then added to the landfill. This process was repeated until the landfill was brought to grade and a final covering of fill material was applied. Portions of this cover reportedly contain clay. Where present, the clay reduces the permeability of the cover.

The southern landfill was brought to grade in 1963 and was subsequently closed. Some time after its closure, the southern landfill received a covering of fill. The thickness of this cover is unknown. In 1977, the Town of North Hempstead began excavating a portion of the southern landfill for the construction of a swimming pool. Waste material that was uncovered during this excavation was reportedly well decomposed and contained wood, metal, and plastic debris. At the present time, this landfill is the site of the North Hempstead Park Physical Activities Center and numerous athletic fields and playing courts. The park has had several incidences of structural damage which are due to the settling of the landfill. The southern landfill is unlined and generates an estimated 22,100 gallons of leachate per day.

In 1974, the northern landfill was brought to grade and approximately 90 percent of its surface was covered with a layer of clayey fill. This cover is reportedly 3 ft to 4 ft thick in some areas. Shortly after the cover was applied to it, methane began migrating from the northern landfill. In an effort to alleviate this problem, vent pipes and a venting trench were installed at the site. Despite these measures, methane fires and an area of cracked ground and stressed vegetation allegedly occurred at the northern landfill in 1978. At the same time, a portion of the northern landfill was excavated for the construction of a Police Boy's Club. Air screening of the excavated area revealed the presence of methane at concentrations that exceeded the lower explosive limit. The northern landfill (excluding the area of the Police Boy's Club) is currently an undeveloped field; it is unlined, and generates an estimated 14,060 gallons of leachate per day.

It should be noted that the two on-site incinerators were shut down in 1977 and have been removed. The former location of the incinerators is presently occupied by a garage that is operated by the North Hempstead Department of Public Works.

There have been several incidents of miscellaneous dumping at the site. The available information indicates that the southern half of the site may have been used as a landfill prior to its purchase by the Town of North Hempstead. The type and quantity of waste that may have been accepted during that time is unknown. During the NUS Region 2 FIT site reconnaissance on June 6, 1989, NCDOH and NUS personnel observed a PVC pipe extending onto the northern landfill from an adjoining property. At the time, the pipe was discharging a thin stream of viscous liquid onto the site property. Closer inspection revealed the effluent to have a golden tinge and a pervasive odor The runoff from this pipe appeared to flow south toward a low-lying area of the site. During the NUS Region 2 FIT site inspection conducted on June 14 and 15, 1989, the area of the discharge pipe was reinspected. In the time since the site reconnaissance, the discharge had been discontinued and approximately 12 ft of pipe had been removed. The length of the remaining section of pipe could not be determined; however, it allegedly connects to a storm drain on the adjoining property. Cement had been used to plug the open end of this pipe. A soil sample was collected from the former point of discharge. Analysis of this sample revealed the presence of benzo (b) fluoranthene, benzo (k) fluoranthene, and Aroclor-1254, and elevated levels of zinc.

Other incidents of miscellaneous dumping may have occurred at the site. Analysis of a soil sample (NYED-S3) that was collected near a crushed bucket on the northern landfill revealed the presence of metals, SVOCs, pesticides, and Aroclor-1254. Analysis of a sediment sample (NYEB-SED2), which was collected from an area of ponded water located downslope of, and approximately 100 ft southeast of, the former discharge pipe, revealed the presence of Aroclor-1254. Analysis of a soil sample (NYEB-S1), which was collected from an area of excavated pavement on the southern landfill, revealed the presence of metals, SVOCs, and Aroclor-1260.

The site may pose a potential threat of fire. Methane-related fires have previously occurred at the northern landfill. During the FIT 2 site inspection, elevated organic vapor analyzer (OVA) readings were detected in the breathing zone at an area on the northern landfill. These readings may indicate the continued migration of methane from the site. There is a potential for the direct contact of people with on-site contaminants. PCBs, SVOCs, and pesticides have been detected in the surface soils on the northern landfill. The northern landfill is fenced; however, access is not restricted by a locked gate. A number of area youths were observed on this property during the FIT 2 site inspection on June 14, and 15, 1989. The southern landfill also poses a threat of direct contact. A PCB and a SVOC were detected in an area of excavated pavement. Extensive construction work is taking place in this area, and a high potential exists for the direct contact of workers with contaminated soils.

Ref. Nos. 1, 2, 6, 17

2.3 GROUNDWATER ROUTE

The Denton Avenue Landfill is underlain by the Upper Glacial Aquifer, the Magothy Formation, and the Lloyd Aquifer. The aquifer of concern in the vicinity of the site is the Magothy Formation and the overlying, hydraulically connected, Upper Glacial Aquifer. The Lloyd Aquifer is not included in the aquifer of concern because it is overlain by an extensive clay confining layer and very few wells tap this formation within 3 miles of the site.

In the area of the site, the uppermost portion of the Magothy Formation is characterized by fine to medium sand, with mica and interstitial silt and clay. Based on well logs from the site, the depth to the Magothy Formation is approximately 100 ft to 105 ft below grade. The thickness of this formation is estimated to be 325 ft. The Magothy Formation is the primary source of potable water for Nassau County. Groundwater typically occurs under unconfined conditions in the upper portion of this formation. Monitoring wells DA-1 and DA-5 are reportedly screened in the upper 5 ft of the Magothy Formation.

The Upper Glacial Aquifer overlies the Magothy Formation. In the area of the site, the Upper Glacial Aquifer is characterized by fine to coarse sand, fine to coarse gravel, and small cobbles. The northern and southern landfills are constructed in the glacial deposits. Groundwater typically occurs under unconfined conditions in this aquifer. Based on well logs from the site, the water table is located approximately 13 ft to 34 ft below the bottoms of the landfills. Monitoring wells DA-2, DA-3, and DA-4 are screened in the upper glacial aquifer.

The depth to groundwater at the site ranges from approximately 58 ft to 79 ft below grade. Groundwater in this area reportedly flows through the Upper Glacial and Magothy Aquifers in an east-to-west direction. The rate of flow through these aquifers is estimated to be 0.76 ft per day. The unsaturated zone that overlies the aquifer of concern consists of a mixture of medium coarse sand, gravel, and municipal refuse. Areas of clayey sand are present on the northern landfill. The hydraulic conductivity that is associated with these deposits is estimated to be 10^{-3} cm/sec. Net annual precipitation for this area, calculated as the difference between normal annual total precipitation and mean annual lake evaporation, is 13 inches.

Most, if not all, of the people living within 3 miles of the site are served by integrated supply systems that draw on wells located within the 3 mile radius. There are a minimal number of private wells that are used in this area of Nassau County. A small portion of Queens County is included within the 3-mile radius. The source of drinking water for the residents in this area is not known. The nearest potable well to the site is Jamaica Water Supply Co. Well No. 20. This well is 464.83 ft deep and it is located approximately 125 feet south of the site. Jamaica Water Supply Co. Well No. 20 is part of an integrated supply system that serves between 33,000 and 130,000 people. U.S. EPA has designated all of the aquifers that underlie this region as part of a sole source aquifer system.

On June 14 and 15, 1989, NUS Corporation Region 2 FIT collected six groundwater samples (including one environmental duplicate) to determine the presence or absence of contaminants that are attributable to the site. Two downgradient samples (NYEB-GW2 and NYEB-GW3) were collected from monitoring wells DA-3 and DA-4, respectively. A third downgradient sample (NYEB-GW4) was collected from a public supply well (Jamaica Water Supply Co. Well No. 20) located approximately 125 ft south of the site. One upgradient sample (NYEB-GW5) was collected from a public supply well (N-3673) located approximately 250 ft east of the site. A second upgradient sample, (NYEB-GW6) and the duplicate sample (NYEB-GW7) were collected from a public supply well (N-5603) located approximately 1000 ft northeast of the site. Monitoring wells DA-3 and DA-4 are 95 ft deep and are screened in the upper glacial aquifer. Public supply wells Jamaica Water Supply Co. Well No. 20, N-3673, and N-5603 range in depth from 415 ft to 464.83 ft and are screened in the Magothy Formation.

Analysis of the groundwater samples suggests a potential for the release of iron and manganese to groundwater. Iron and manganese were detected in the downgradient monitoring wells, at concentrations that significantly exceeded federal drinking water standards. Neither of these metals was present above the contract required detection limits (CRDLs) in the upgradient samples. Iron and manganese are commonly associated with landfill leachate; therefore, their presence in the groundwater may be attributable to the site. A release of contaminants to groundwater cannot be documented at this site because the upgradient public supply wells were screened at a much greater depth than the downgradient monitoring wells. Sample analysis also revealed the presence of elevated levels of chromium, lead, nickel, and zinc in the downgradient monitoring wells. These metals are also associated with landfill leachate, and their presence in the groundwater may be attributable to the site. It should also be noted that chlorinated hydrocarbons were detected in all of the public supply wells that were sampled. These compounds are known to be present throughout the aquifer of concern, in this area of Nassau County. The source of these compounds may be solvent waste from local dry cleaning businesses. These compounds are not attributable to the site; therefore, they do not contribute to the site's impact on groundwater. The sample results are summarized below:

Compounds Present Above CRDLs	Highest Upgradient Concentration	Sample Location	Highest Downgradient Concentration	Sample Location
Chromium*	BCRDL (DL-10ug/L)	NYEB-GW5, NYEB-GW6	404	NYEB-GW2
Iron*	ND	NYEB-GW6, NYGB-GW7	363,000	NYEB-GW2
Lead*	BCRDL (DL-5 ug/L)	NYEB-GW6, NYEB-GW7	337	NYEB-GW2
Manganese*	ND	NYEB-GW6, NYGB-GW7	1,430	NYEB-GW3
Nickel	ND	NYEB-GW5, NYGB-GW6, NYGB-GW7	250	NYEB-GW2
Zinc*	BCRDL (DL-20 ug/L)	NYEB-GW5, NYEB-GW6, NYEB-GW7	215	NYEB-GW2

* Indicates compound was detected at a concentration that exceeds Federal Drinking Water Standards.

Note 1: All results are expressed in units of ug/L.

Note 2: NYEB-GW6 and NYGB-GW7 are duplicate samples.

BCRDL - Below Contract Required Detection Limit

ND - Not Detected

DL - Detection Limit

Ref. Nos. 1, 2, 4, 5, 7, 10, 11, 12, 14, 15, 16, 17

2.4 SURFACE WATER ROUTE

A county-owned recharge basin is located in a low-lying area between the northern and southern landfills. According to the NCDOH, all site-generated runoff and leachate migrates into this recharge basin. The basin is man-made and serves to replenish the local groundwater supply by collecting precipitation and stormwater runoff. There are no migration pathways leading from the basin to naturally occurring surface water; however, it is hydraulically connected to the Upper Glacial Aquifer.

There are no sensitive environments or critical habitats of federally-listed endangered species located within 1 mile of the site. The 1-year 24-hour rainfall for this area is approximately 2.7 inches.

There is a high potential for site contaminants to enter the aquifer of concern via the recharge basin. Drainage pathways, leading from the northern landfill into the recharge basin, were observed during the FIT 2 site inspection. A soil sample (NYEB-S7) was collected from one of these pathways. Analysis of this sample revealed the presence of magnesium at 1,000 times the concentrations found in the other on-site soil samples. A sediment sample (NYEB-SED1) was collected at the bottom of the drainage pathway. Analysis of this sample revealed the presence of barium at 182 times the concentration found in the other on-site sediment sample (NYEB-SED2). Lead and manganese were detected at twice the concentrations frourd in NYEB-SED2. Magnesium was detected at more than 2,000 times the concentration detected in NYEB-SED2. Vanadium was detected at 25 times the concentration detected in NYEB-SED2. Zinc was detected at 4 times the concentration detected in NYEB-SED2. A surface water sample was collected at the same location. Analysis of this sample indicates the presence of iron, lead, and manganese at levels that exceed the federal drinking water standards. In addition to metals, SVOCs, pesticides, and PCBs have been detected in the on-site soils. These compounds may be carried by stormwater runoff into the recharge basin.

Ref. Nos. 1, 2, 4, 8, 17

2.5 AIR ROUTE

Readings above background were detected on the HNu photoionization detector (HNu) and the OVA flame ionization detector (OVA) during the NUS Corporation Region 2 FIT site reconnaissance conducted on June 6, 1989. The HNu readings were detected near the ground at four locations on the site. Three of the readings were detected in the vicinity of the vent pipes on the northern parcel; the fourth reading was detected in an excavated area on the southern parcel. The highest reading, 20 parts per million (ppm) above background, was detected approximately 30 feet east of vent pipes Nos. 21 and 22 on the northern parcel. No HNu readings were detected in the breathing zone during the FIT 2 site reconnaissance. OVA readings ranging from 800 ppm to more than 1000 ppm above background were detected inside the casings of monitoring well (MW) Nos. DA-3, DA-4, and DA-5, after uncapping. All of these readings subsequently dropped to background levels as the wells were allowed to vent. A methane flush test was performed at each well and the tests revealed the presence of methane. OVA readings were detected at three locations on the northern parcel. All of the readings were detected in the vicinity of the vent pipes. The highest reading, 30 ppm above background, was detected at a crushed pail located approximately 30 feet east of vent No. 14. No OVA readings were detected in the breathing zone during the FIT site reconnaissance.

No readings above background were detected on the HNu during the NUS Region 2 FIT site inspection conducted on June 14 and 15, 1989. Variable OVA readings were detected inside the casings of MW Nos. DA-3 and DA-4 prior to, and during, their evacuation. The highest reading, 60 ppm above background, was detected in MW No. DA-3 after the water column was disturbed. The readings gradually dropped to background levels as the wells were allowed to vent. An OVA reading of approximately 900 ppm above background was detected inside the casing of MW No. DA-5 after uncapping. This reading subsequently dropped to 150 ppm above background after the well had vented for three hours. No OVA readings were detected in the breathing zone during the collection of groundwater samples. OVA readings were detected prior to, and after, disturbing the soil at sample location Nos. NYEB-S1 and NYEB-S4. The highest reading, 10 ppm above background, was detected at sample location No. NYEB-S4. An OVA reading of 2 ppm was detected after the disturbance of the sediments at sample location No. NYEB-SED2; an OVA reading of 1 ppm was also detected in the breathing zone at this location. An OVA reading of 1.5 ppm above background, was also detected at the surface of the water at this location. No OVA readings were detected in the breathing zone during the collection of the soil samples. An OVA reading of 6 ppm above background was detected in the breathing zone at sample location Nos. NYEB-S7, NYEB-SW1, and NYEB-SED1. OVA readings, ranging from 50 ppm to 70 ppm above background, were detected in the breathing zone at the top of the drainage pathway from which sample No. NYEB-S7 was collected. A methane flush test was performed at this location and was unable to confirm the presence of methane. An OVA reading of greater than 1000 ppm above background was detected at the ground surface in this area. Subsequent screening of this area using Draeger tubes did not reveal the presence of benzene or vinyl chloride in the ambient air.

Approximately 390,000 people reside within 4 miles of the site. There are no historical landmarks that are visible from the site.

The majority of the site is vegetated and there is a limited potential for a release of contaminants to air. PCBs and pesticides that were detected in the on-site soils may be attached to soil particles and become airborne during dry, dusty conditions. Based on air readings that were detected during the FIT 2 site inspection, volatile compounds, other than methane, may be present at the northern landfill.

Ref. Nos. 1, 2, 3, 17

2.6 ACTUAL HAZARDOUS CONDITIONS

The actual hazardous conditions that are present at the site are summarized below:

- The potential exists for contamination of the potable water supply with chromium, iron, lead, manganese, and zinc.
- The potential exists for direct contact of people with contaminated soils that are present on site.
- Areas of stressed vegetation were observed at the northern landfill by a local fire chief on October 10, 1978. These stressed areas were allegedly due to elevated levels of methane.
- The site has a history of methane fires. Elevated levels of methane were detected at the northern landfill in 1976 and 1978. In September 1976, the on-site venting trench caught fire when town officials applied a lighted match to it. In September 1978, the NCDOH received a compliant from the Garden City Park Fire Chief regarding the occurrence of methane fires at the northern landfill. According to the Nassau County Fire Marshall's office, the site does not currently pose a significant threat of fire.

No other actual conditions pertaining to human or environmental contamination have been documented. Specifically:

- Contamination has not been documented either in organisms in a food chain leading to humans or in organisms directly consumed by humans.
- There has been no documented contamination of a sewer or storm drain without a point source to which the contamination can be attributed.
- There has been no documented damage to fauna.

Ref. Nos. 1, 2, 17

3.0 MAPS AND PHOTOS

DENTON AVENUE LANDFILL
NEW HYDE PARK, NEW YORK

CONTENTS

(QUAD) SEA CLIFF, N.Y.

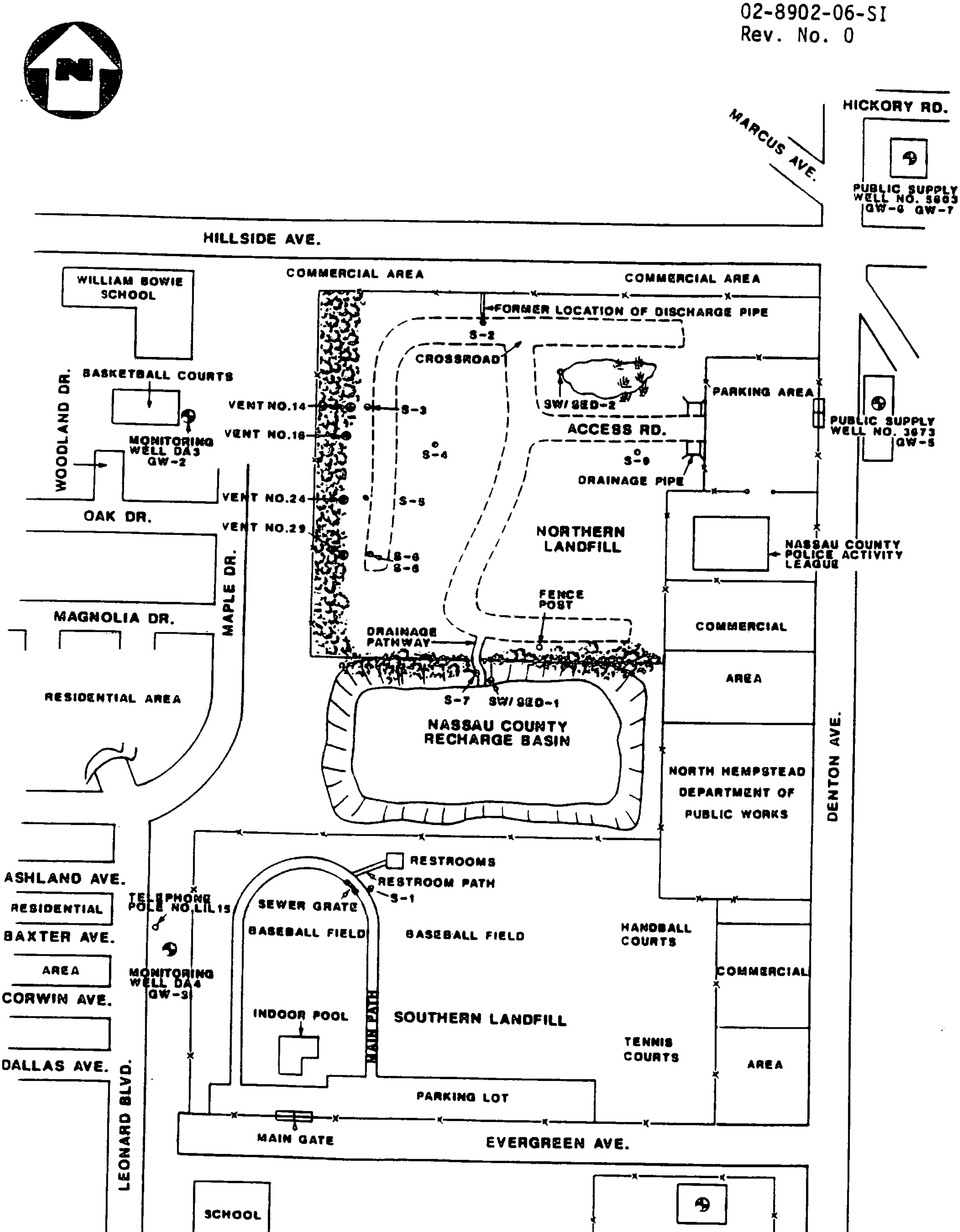
FIGURE 1

SITE LOCATION MAP

DENTON AVENUE LANDFILL, NEW HYDE PARK, N.Y.

NUS CORPORATION

SCALE: 1" = 2000'



LEGEND

WOODS
WELL
SAMPLES

GW-GROUNDWATER
SW-SURFACE WATER

S-SOIL
SED-SEDIMENT

NOTE: ALL SAMPLE NUMBERS PRECEDED BY NYEB.

SAMPLE LOCATION MAP

DENTON AVENUE LANDFILL, NEW HYDE PARK, NY

NOT TO SCALE

FIGURE 2

NUS CORPORATION

EXHIBIT A

PHOTOGRAPH LOG

DENTON AVENUE LANDFILL
NEW HYDE PARK, NEW YORK

SITE RECONNAISSANCE: JUNE 6, 1989
SITE INSPECTION: JUNE 14 and 15, 1989

DENTON AVENUE LANDFILL
NEW HYDE PARK, NEW YORK
JUNE 6, 14, and 15, 1989

PHOTOGRAPH LOG

ALL PHOTOGRAPHS TAKEN BY BRIAN DIETZ.

Photo Number	Description	Time
1P-7,8	June 6, 1989 Panoramic view of southern landfill as seen from the parking lot.	1054
1P-22	June 6, 1989 Looking northwest across the recharge basin that divides the site.	1133
2P-9	June 6, 1989 Picture of PVC pipe dicharging onto the northern landfill.	1254
2P-17,18	June 6, 1989 Panoramic view of the northern landfill looking north from the recharge basin.	1311
1P-1	June 14, 1989 Anthony Culmone collecting soil sample S-1.	1050
1P-3	June 14, 1989 Steve Okulewicz collecting sediment sample SED-2.	1214
1P-4	June 14, 1989 Steve Okulewicz collecting soil sample S-2.	1243
1P-5	June 14, 1989 Steve Okulewicz collecting soil sample S-3.	1317
1P-6	June 14, 1989 Anthony Culmone collecting soil sample S-4.	1526
1P-7	June 14, 1989 Steve Okulewicz collecting soil sample S-5 (MS/MSD).	1547

DENTON AVENUE LANDFILL
NEW HYDE PARK, NEW YORK
JUNE 6, 14, and 15, 1989

PHOTOGRAPH LOG
(con't)

Photo Number	Description	Time
1P-8	June 14, 1989 Anthony Culmone collecting soil sample S-6/S-8 (dup).	1615
1P-9	June 14, 1989 Anthony Culmone collecting surface water sample SW-1.	1737
1P-10	June 14, 1989 Anthony Culmone collecting sediment sample SED-1.	1743
1P-12	June 14, 1989 Steve Okulewicz collecting soil sample S-7.	1837
1P-14	June 14, 1989 Steve Okulewicz collecting soil sample S-9.	1855
1P-15	June 15, 1989 Anthony Culmone and Steve Okulewicz collecting groundwater sample GW-2.	1055
1P-16	June 15, 1989 Anthony Culmone collecting tap water sample GW-1 (MS/MSD).	1341
1P-17	June 15, 1989 Anthony Culmone collecting tap water sample GW-5.	1507
1P-18	June 15, 1989 Anthony Culmone collecting tap water sample GW-6/GW-7 (dup).	1525
1P-19	June 15, 1989 Anthony Culmone and Steve Okulewicz collecting groundwater sample GW-3.	1646

DENTON AVENUE LANDFILL, NEW HYDE PARK, NEW YORK

22

1P-7,8

June 6, 1989
Panoramic view of southern landfill as seen from the parking lot.

1054

DENTON AVENUE LANDFILL, NEW HYDE PARK, NEW YORK

1P-22 June 6, 1989 1133
Looking northwest across the recharge basin that divides the site.

2P-9 June 6, 1989 1254
Picture of PVC pipe discharging onto the northern landfill.

DENTON AVENUE LANDFILL, NEW HYDE PARK, NEW YORK

24

2P-17,18

June 6, 1989
Panoramic view of the northern landfill looking north from the recharge basin.

1311

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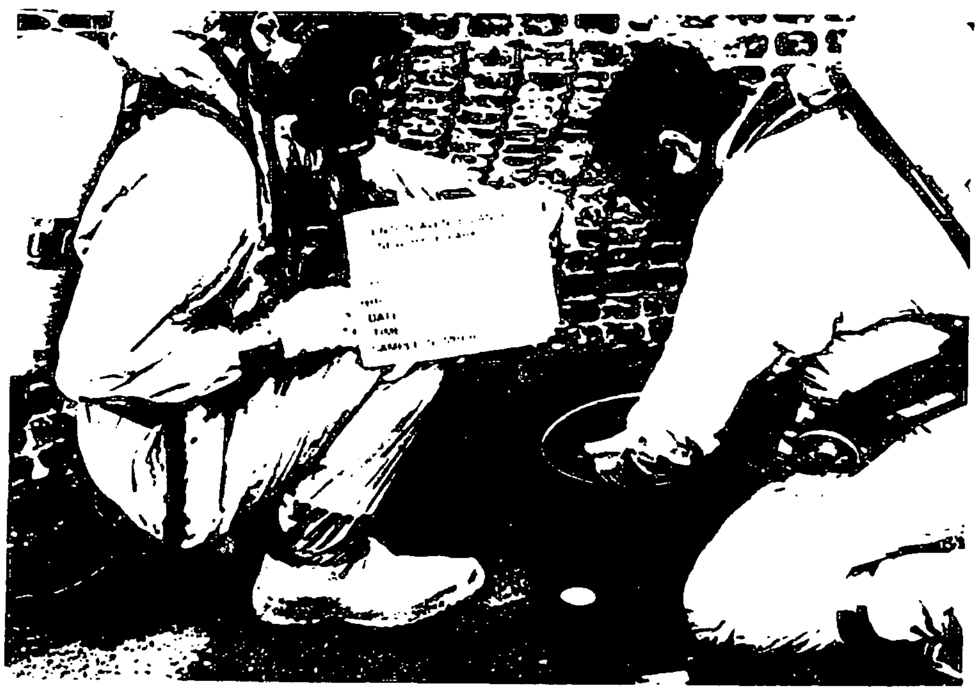
02-8902-06-SI
Rev. No. 0

DENTON AVENUE LANDFILL, NEW HYDE PARK, NEW YORK



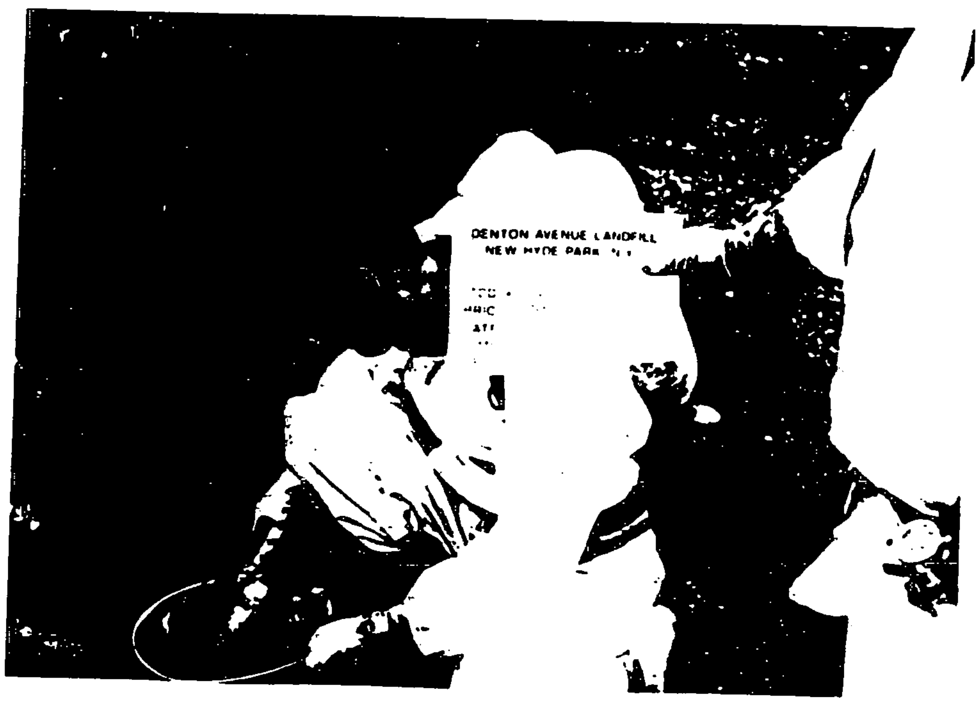
1P-1

June 14, 1989 1050
Anthony Culmone collecting soil sample S-1.

DENTON AVENUE LANDFILL, NEW HYDE PARK, NEW YORK

1P-3

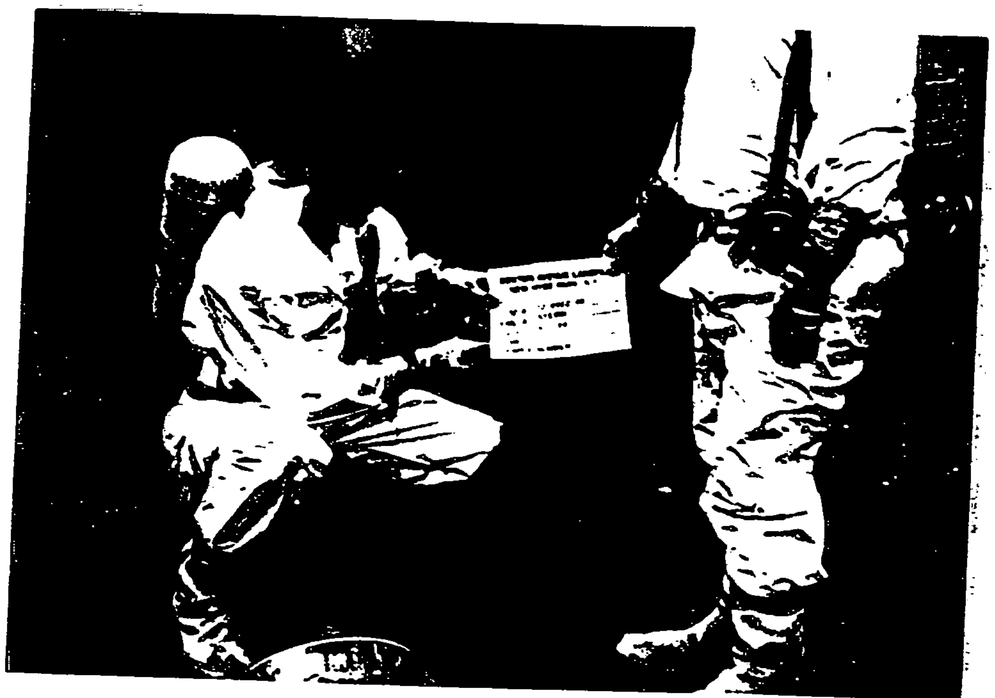
June 14, 1989 1214
Steve Okulewicz collecting sediment sample SED-2. (Note: The sample placard is mis-numbered in this photo).



1P-4

June 14, 1989 1243
Steve Okulewicz collecting soil sample S-2.

DENTON AVENUE LANDFILL, NEW HYDE PARK, NEW YORK



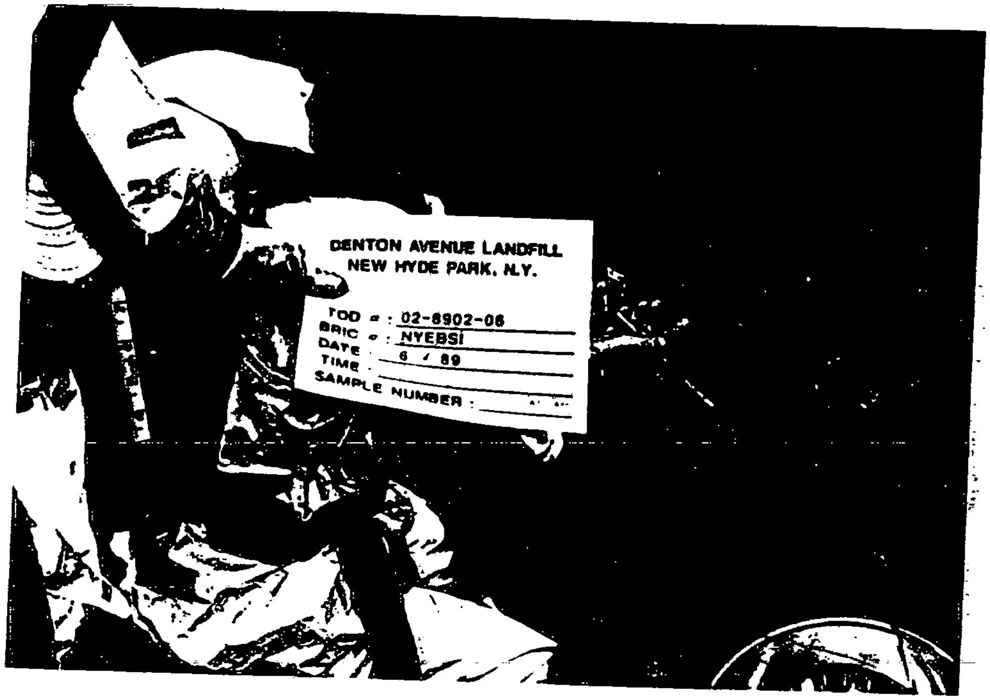
1P-5

June 14, 1989 1317
Steve Okulewicz collecting soil sample S-3.

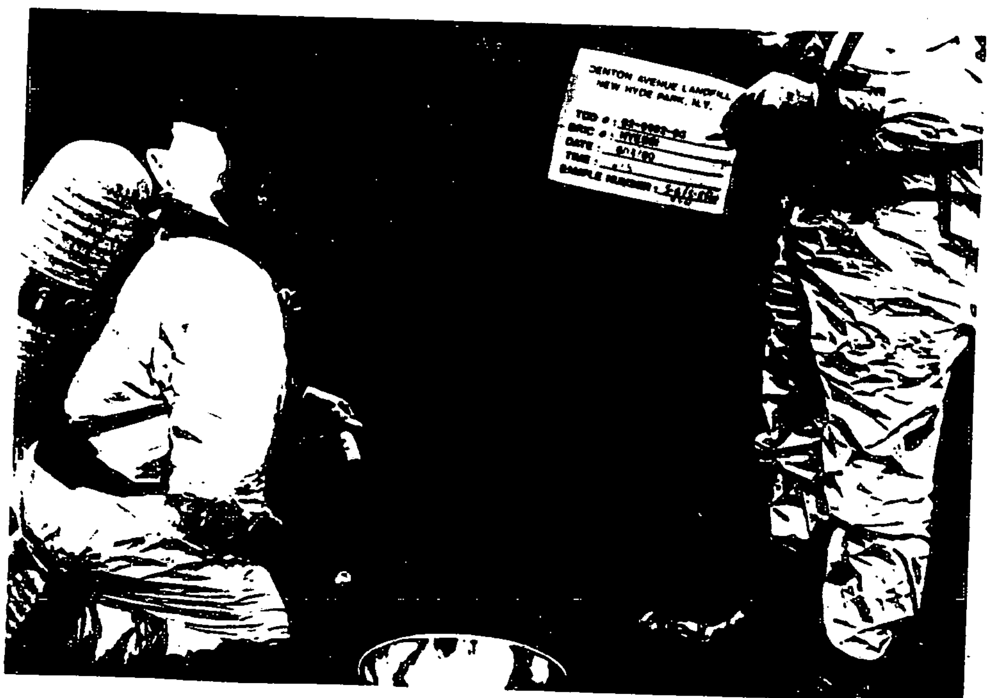
1P-6

June 14, 1989 1526
Anthony Culmone collecting soil sample S-4.

DENTON AVENUE LANDFILL, NEW HYDE PARK, NEW YORK



1P-7 June 14, 1989 1547
Steve Okulewicz collecting soil sample S-5 (MS/MSD)

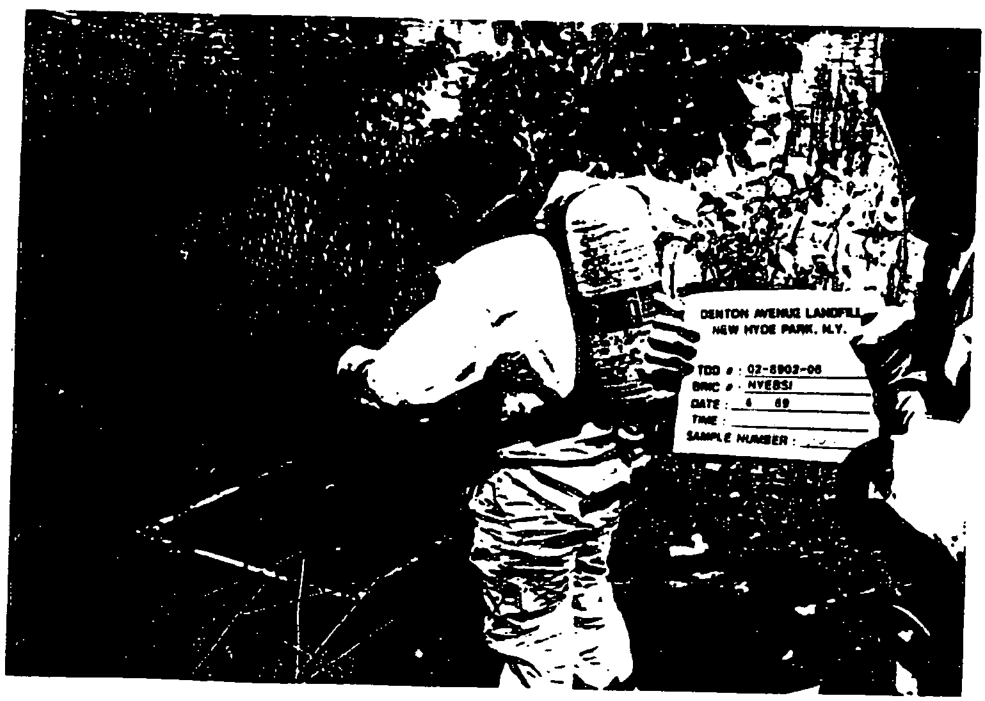


1P-8 June 14, 1989 1615
Anthony Culmone collecting soil sample S-6/ S-8 (dup).

DENTON AVENUE LANDFILL, NEW HYDE PARK, NEW YORK

1P-9

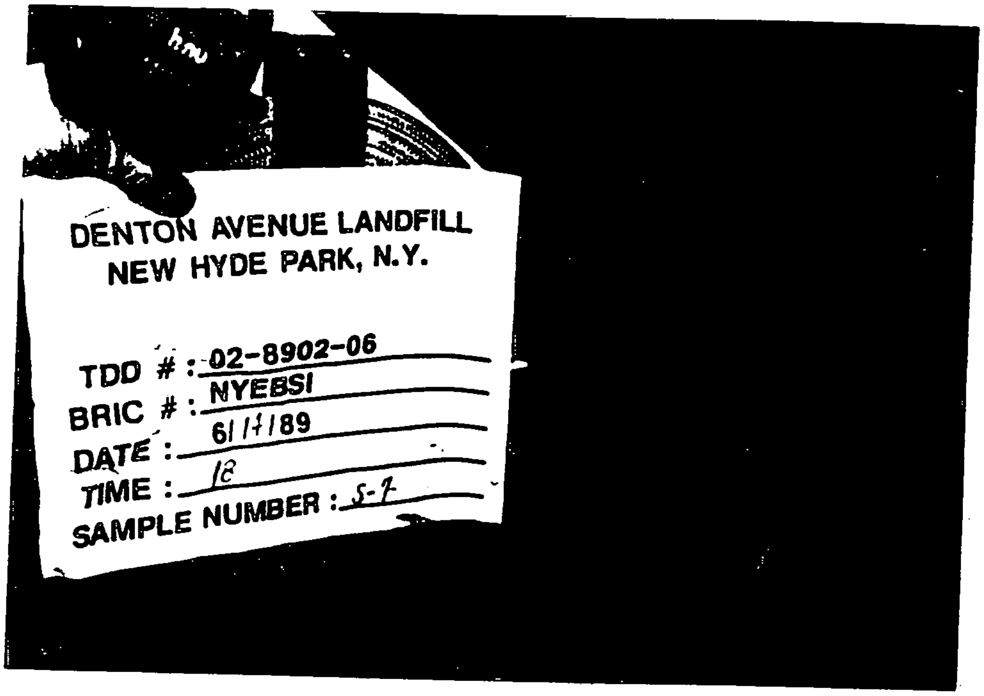
June 14, 1989 1737
Anthony Culmone collecting surface water sample SW-1.



1P-10

June 14, 1989 1743
Anthony Culmone collecting sediment sample SED-1.

DENTON AVENUE LANDFILL, NEW HYDE PARK, NEW YORK



IP-12 June 14, 1989 1837
Steve Okulewicz collecting soil sample S-7.

IP-14 June 14, 1989 1855
Steve Okulewicz collecting soil sample S-9.

DENTON AVENUE LANDFILL, NEW HYDE PARK, NEW YORK

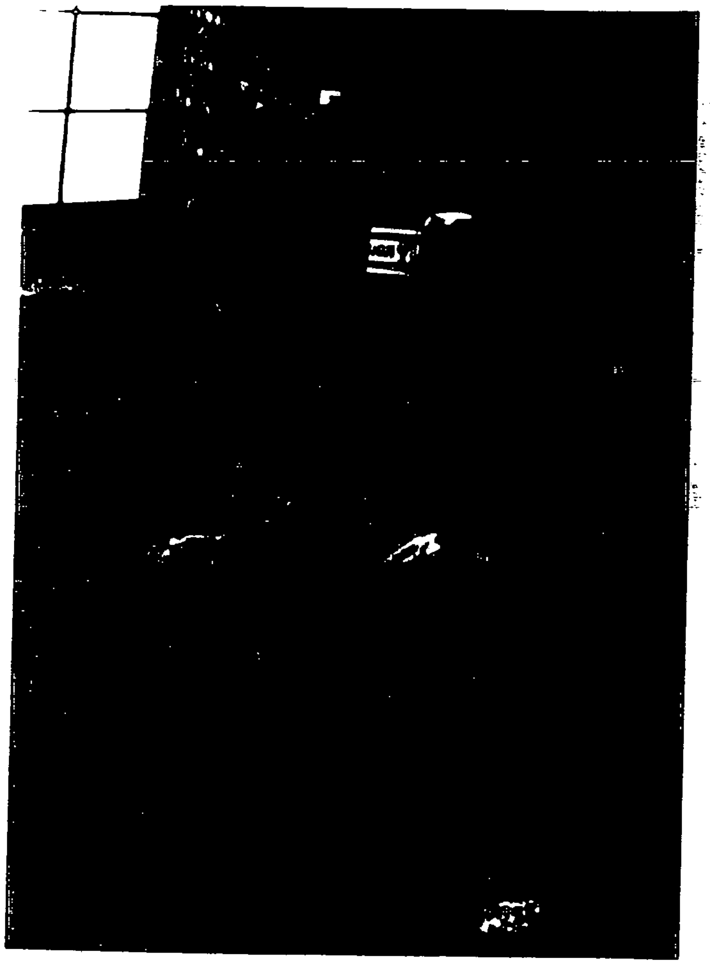
IP-15

June 15, 1989
Anthony Culmone and Steve Okulewicz
collecting groundwater sample GW-2.

1055

NUS CORPORATION

DENTON AVENUE LANDFILL, NEW HYDE PARK, NEW YORK



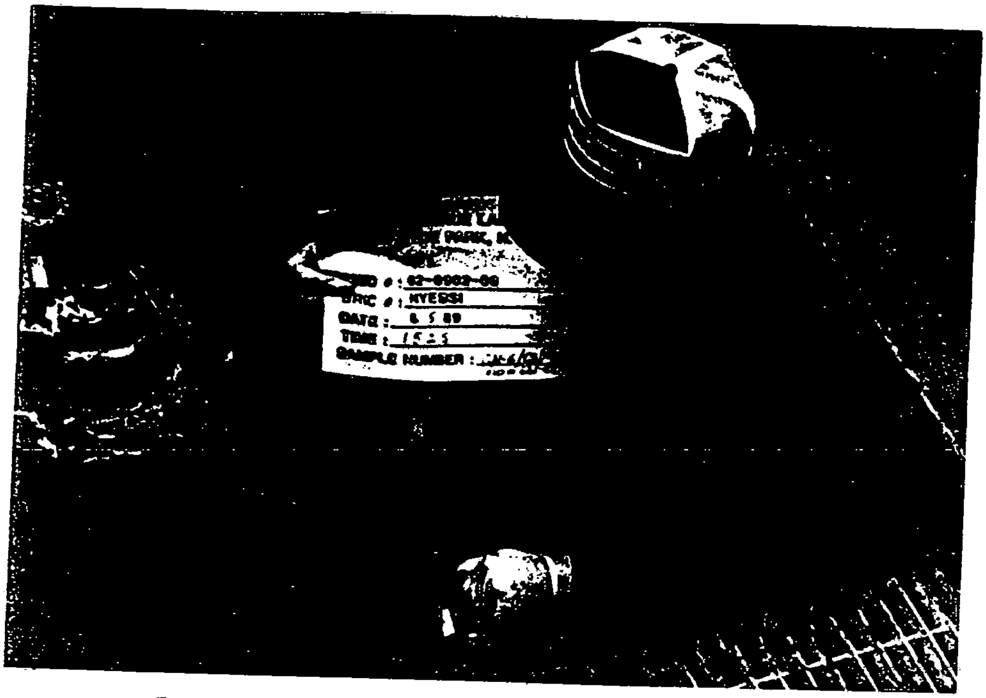
IP-16 June 15, 1989 1341

Anthony Culmone collecting tap water sample GW-1 (MS/MSD).

IP-17

June 15, 1989 1507
Anthony Culmone collecting tap water sample GW-5.

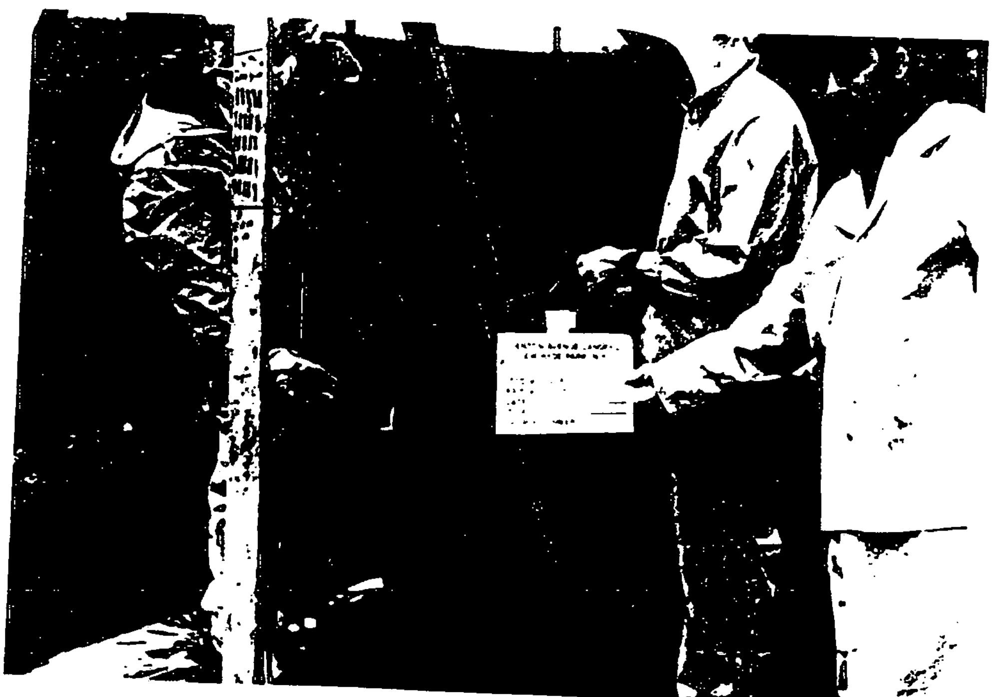
DENTON AVENUE LANDFILL, NEW HYDE PARK, NEW YORK



1P-18

June 15, 1989
Anthony Culmone collecting tap water sample GW-6/GW-7 (dup).

1525



1P-19

June 15, 1989
Anthony Culmone and Steve Okulewicz collecting groundwater sample GW-3.

1646

4.0 SITE INSPECTION SAMPLING RESULTS

Six groundwater samples, two surface water samples, two sediment samples, and nine soil samples (including one environmental duplicate for each matrix) were collected during the NUS Region 2 FIT site inspection conducted on June 14 and 15, 1989.

Analyses of the groundwater samples indicate the presence of chromium, iron, lead, and manganese, at levels that exceed federal drinking water standards, in the downgradient monitoring wells (MWs) DA-3 and DA-4. The highest concentrations of chromium (404 ug/L), iron (363,000 ug/L), and lead (337 ug/L) were detected in MW-DA3 (sample No. NYEB-GW2). The highest concentration of manganese (1,430 ug/L) was detected in MW-DA4 (sample No. NYEB-GW3). Tetrachloroethene and trichloroethene were detected in all of the public supply wells sampled. The highest concentrations of these compounds (640 ug/L and 8 ug/L, respectively) were detected in public supply well N-5603 (sample No. NYEB-GW6/7).

Analyses of the surface water samples indicate the presence of iron, lead, and manganese, at levels that exceed federal drinking water standards. The highest concentrations of iron (19,800 ug/L) and lead (105 ug/L) were detected in sample No. NYEB-SW1. The highest concentration of manganese (779 ug/L) was detected in sample No. NYEB-SW2.

Analyses of the sediment samples indicate the presence of barium, lead, magnesium, manganese, vanadium, and zinc. The highest concentrations of barium (182E mg/kg), lead (112 mg/kg), magnesuim (2,190 mg/kg), manganese (204 mg/kg), vanadium (25.9E mg/kg), and zinc (169E mg/kg), were detected in sample No. NYEB-SED1. These concentrations were approximately 2 to 200 times greater than those that were detected in the other sediment sample (NYEB-SED1). Aroclor-1254 was detected in sample No. NYEB-SED2 at a concentration of 210 ug/kg.

Analyses of the soil samples indicate the presence of arsenic, barium, cadmium, chromium, lead, manganese, vanadium and zinc, in the on-site soils. The highest concentrations of cadmium (1.7E mg/kg), chromium (19.2 mg/kg), lead (287 mg/kg), vanadium (445 mg/kg) and zinc (6,700 mg/kg) were detected in sample No. NYEB-S3. These concentrations were approximately 1 to 51 times greater than those that were detected in the other soil samples. The highest concentrations of arsenic (9.6 mg/kg) and barium (62E mg/kg) were detected in sample No. NYEB-S1. These concentrations were 2 to 62 times greater than those that were detected in the other soil samples. The highest concentration of manganese was detected in sample No NYEB-S7 This concentration was approximately 2 times greater than those that were detected in the other soil samples. SVOCs were detected in sample Nos. NYEB-S1, NYEB-S2, and NYEB-S3 The concentrations of the SVOCs ranged from 610 ug/kg to 3,300 ug/kg. With the exception of bis(2-ethylhexyl) phthalate, the highest concentration of SVOCs were detected in sample No. NYEB-S3; pyrene and benzo(b)fluoranthene were present in the highest concentration (3,300 ug/kg). The pesticides dieldrin (28 ug/kg), 4,4'-DDE (42 ug/kg), and 4,4'-DDD (47 ug/kg) were detected in sample No. NYEB-S3. PCBs were detected in the on-site soils at concentrations ranging from 390 ug/kg to 4,200 ug/kg. Aroclor-1254 was detected in sample Nos. NYEB-S2 and NYEB-S3. The highest concentration (440 ug/kg) was detected in sample No. NYEB-S2. Aroclor-1260 was detected in sample No. NYEB-S1 at a concentration of 4,200 ug/kg.

The groundwater sampling results are summarized in Table 3. The surface water sampling results are summarized in Table 4. The sediment sampling results are summarized in Table 5. The soil sampling results are summarized in Table 6. Figure 2 in Section 3.0 provides a sample location map.

TABLE 3. Groundwater Sampling Results

Compounds Present Above CRDLs	Sample Location(s) Where Compounds Detected	Sample with Highest Concentration	Highest Concentration
Aluminum	NYEB-GW2, NYEB-GW3	NYEB-GW2	1,550
Chromium*	NYEB-GW2, NYEB-GW3	NYEB-GW2	404
Copper	NYEB-GW2, NYEB-GW5	NYEB-GW2	172
Iron*	NYEB-GW2, NYEB-GW3, NYEB-GW4	NYEB-GW2	363,000
Lead*	NYEB-GW2, NYEB-GW3	NYEB-GW2	337
Magnesium	NYEB-GW1, NYEB-GW6, NYEB-GW7	NYEB-GW1	7,900
Manganese*	NYEB-GW2, NYEB-GW3	NYEB-GW3	1,430
Nickel	NYEB-GW2, NYEB-GW3	NYEB-GW2	250
Zinc	NYEB-GW2, NYEB-GW3	NYEB-GW2	215
Trichloroethene	NYEB-GW6, NYEB-GW7	NYEB-GW7	8
Tetrachloroethene	NYEB-GW1, NYEB-GW5, NYEB-GW6, NYEB-GW7	NYEB-GW6	640

* - Indicates compound was detected at a concentration that exceeds Federal Drinking Water Standards.

Note 1: All results are expressed in units of ug/L.

Note 2: Sample Nos. NYEB-GW6 and NYEB-GW7 are duplicate samples.

TABLE 4. Surface Water Sampling Results

Compounds Present Above CRDLs	Sample Location(s) Where Compounds Detected	Sample with Highest Concentration	Highest Concentration
Aluminum	NYEB-SW1	NYEB-SW1	13,900
Chromium	NYEB-SW1	NYEB-SW1	30
Copper	NYEB-SW1	NYEB-SW1	36.7
Iron*	NYEB-SW1, NYEB-SW2	NYEB-SW1	19,800
Lead*	NYEB-SW1, NYEB-SW2	NYEB-SW1	105
Magnesium	NYEB-SW1, NYEB-SW2	NYEB-SW2	6,460
Manganese*	NYEB-SW1, NYEB-SW2	NYEB-SW2	779
Zinc	NYEB-SW1	NYEB-SW1	363

* - Indicates compound was detected at a concentration that exceeds Federal Drinking Water Standards.

Note: All results are expressed in units of ug/L.

Table 5. Sediment Sampling Results

Compounds Present Above CRDLs	Sample Location(s) Where Compounds Detected	Sample with Highest Concentration	Highest Concentration
Aluminum	NYEB-SED1, NYEB-SED2	NYEB-SED1	7,700
Barium	NYEB-SED1	NYEB-SED1	182E
Chromium	NYEB-SED1, NYEB-SED2	NYEB-SED1	17.9
Iron	NYEB-SED1, NYEB-SED2	NYEB-SED1	14,200
Lead*	NYEB-SED1, NYEB, SED2	NYEB-SED1	112
Magnesium	NYEB-SED1	NYEB-SED1	2,190
Manganese*	NYEB-SED1, NYEB-SED2	NYEB-SED1	204
Nickel	NYEB-SED1, NYEB-SED2	NYEB-SED1	16.1E
Vanadium	NYEB-SED1	NYEB-SED1	25.9E
Zinc*	NYEB-SED1, NYEB-SED2	NYEB-SED1	169E
Aroclor-1254	NYEB-SED2	NYEB-SED2	210

E - Indicates an estimated value.

Note: All results are expressed in units of mg/kg except Aroclor-1260 which is expressed in units of ug/kg.

TABLE 6. Soil Sampling Results

Compounds Present Above CRDLs	Sample Location(s) Where Compounds Detected	Sample with Highest Concentration	Highest Concentration
Aluminum	Present in all soil samples	NYEB-S3	11,900
Arsenic	Present in all soil samples	NYEB-S1	9.6
Barium	NYEB-S1	NYEB-S1	62E
Cadmium*	NYEB-S3	NYEB-S3	1.7E
Chromium*	Present in all soil samples	NYEB-S3	19.2
Iron	Present in all soil samples	NYEB-S3	13,900
Lead*	Present in all soil samples	NYEB-S3	287
Magnesium	NYEB-S7	NYEB-S7	1,820
Manganese	Present in all soil samples	NYEB-S7	187
Nickel	NYEB-S1, NYEB-S3, NYEB-S6, NYEB-S9	NYEB-S3	32.3E
Vanadium*	NYEB-S1, NYEB-S3, NYEB-S6, NYEB-S9	NYEB-S3	445E
Zinc*	Present in all soil samples	NYEB-S3	6,700E
Phenanthrene	NYEB-S3	NYEB-S3	610
Fluoranthrene	NYEB-S3	NYEB-S3	2,500
Pyrene	NYEB-S2, NYEB-S3	NYEB-S3	3,300
Benzo(a)anthracene	NYEB-S3	NYEB-S3	1,700
Chrysene	NYEB-S3	NYEB-S3	1,800
bis(2-ethylhexyl)-phthalate	NYEB-S1, NYEB-S3	NYEB-S1	2,600
Benzo(b)fluoranthene	NYEB-S2, NYEB-S3	NYEB-S3	3,300
Benzo(k)fluoranthene	NYEB-S2, NYEB-S3	NYEB-S3	2,000E
Benzo(a)pyrene	NYEB-S3	NYEB-S3	1,800E
Indeno (1,2,3-cd)pyrene	NYEB-S3	NYEB-S3	740E
Dieldrin	NYEB-S3	NYEB-S3	28
4,4'-DDE	NYEB-S3	NYEB-S3	42
4,4'-DDD	NYEB-S3	NYEB-S3	47
Aroclor-1254	NYEB-S2, NYEB-S3	NYEB-S2	440
Aroclor-1260	NYEB-S1	NYEB-S1	4,200

E - Indicates an estimated value.

Note 1: All metals are expressed in units of mg/kg; the remainder of the results are expressed in ug/kg.

Note 2: Sample Nos. NYEB-S6 and NYEB-S8 are duplicate samples.

Ref. No. 17

5.0 CONCLUSIONS AND RECOMMENDATIONS

A Listing Site Inspection (LSI) is recommended for the Denton Avenue Landfill Site on a **HIGH PRIORITY** basis. The LSI should include the collection of additional soil samples from the southern landfill to determine the extent of PCB contamination in the park area. Additional soil samples should also be collected from the northern landfill to determine the extent of soil contamination. At least one soil sample should be collected from the area where OVA readings of 60 ppm to 70 ppm above background were detected during the FIT 2 site inspection. Subsurface waste samples (from a depth of at least 4 ft) should be collected from the former disposal areas to characterize the nature of the on-site waste. Downgradient monitoring wells DA-1 and DA-2 should be located and sampled. Additional monitoring wells should be installed upgradient of the site ; these wells should be screened at the same depth as the existing downgradient wells. These recommendations are based on the following information that was acquired during the site inspection and subsequent report preparation.

- Groundwater contamination with iron and manganese has been documented. These metals are known constituents of landfill leachate and may be attributable to the site.
- The hydrogeology of the region indicates that the upper glacial and Magothy aquifers are hydraulically connected. The aquifer of concern is included in an U.S. EPA-designated sole source aquifer system.
- At least 54,000 people receive potable water from municipal wells that are located within 2000 ft of the site. The nearest potable well is located approximately 125 ft south of the site and is part of an integrated system that serves 33,000 to 130,000 people.
- The site allegedly generates 13,196,000 gallons of leachate per year.
- A PCB contaminant was detected at the southern landfill in an area of extensive construction. This poses an imminent threat of direct contact by individuals who are working in this area.
- The municipal park that is built on the southern landfill is undergoing extensive renovation. There is a potential for the excavation and transport of PCB-contaminated soils.
- PCBs and pesticides that are present on site may be attached to soil particles and become airborne during dry, dusty conditions.

Ref. Nos. 1, 2, 7, 10, 11, 12, 14, 15, 17

6.0 REFERENCES

1. Engineering Investigations at Inactive Hazardous Waste Sites, Phase I Investigation of Denton Avenue Landfill. EA Science and Technology, June 1987.

2. Field Notebook No. 0420, Denton Avenue Landfill, TDD No. 02-8902-06, on-site reconnaissance performed on June 6, 1989, and site inspection conducted on June 14 and 15, 1989, NUS Corporation Region 2 FIT, Edison, New Jersey.

3. General Sciences Corporation, Graphical Exposure Modelling System (GEMs). Landover, Maryland, 1986.

4. Uncontrolled hazardous waste site ranking system. A user's manual, 40 CFR, Part 300, Appendix A, 1986.

5. Code of Federal Regulations, Protection of the Environment 40, Parts 100 to 149. Revised as of July 1, 1986.

6. Telecon Note: Conversation between Don Speiss, Nassau County Department of Health, and Brian Dietz, NUS Corporation, September 11, 1989.

7. Federal Register, Vol. 43, No. 120, Aquifers Underlying Nassau and Suffolk Counties, New York. Determination published June 21, 1978.

8. Letter from Lawrence Brown, NYSDEC, Significant Habitat Unit, to Brian Dietz, NUS Corporation. April 10, 1989.

9. Telecon Note: Conversation between Nassau County Tax Assessor's Office, and Brian Dietz, NUS Corporation, March 27, 1989.

10. Project Note regarding meeting with John Guarino, Garden City Park Water District, and Brian Dietz, NUS Corporation, July 19, 1989.

11. Letter from Andrew Abate, Jamaica Water Supply Company, to Brian Dietz, NUS Corporation. May 31, 1989.

12. Telecon Note: Conversation between Don Myott, Nassau County Department of Health, Bureau of Public Water Supply, and Brian Dietz, NUS Corporation, March 29, 1989.

13. Three-Mile Vicinity Map based on U.S. Department of the Interior, Geological Survey Topographic Maps, 7.5-minute Quadrangles for "Lynbrook, N.Y.", 1969; "Sea Cliff, N.Y.", 1979; "Freeport, N.Y.", 1979; "Hicksville, N.Y.", 1979.

14. Canter, L. et al. Groundwater quality protection. Chelsea, Michigan, Lewis Publishers, Inc.

15. N.E. McClymonds, N.E. and O.L. Franke, Water-Transmitting Properties of Aquifers on Long Island, New York. Geological Survey Professional Paper 627-E, 1972.

16. Analytical results for groundwater sampling of municipal well Nos. N-3672, N-5603, and N-20. Sample analysis conducted by H2M Labs, Inc.

17. U.S. EPA Contract Laboratory Program, Compu Chem Laboratories (Organic Analysis), Skinner & Sherman, Inc. (Inorganic Analysis), Case No. 12105, Laboratory Analysis from NUS Region 2 FIT Site Inspection conducted on June 14 and 15, 1989.

REFERENCE NO. 7

Excerpt from personal logbook, Katharine Siders Franklin, Dynamac Corporation.

4/7/93 KSF

Recon. activities: Denton Ave. Landfill - Met Susan Boone. Discussed data needs, procedures.

Proceeded to TNH DPW.

Meeting with Town of North Hempstead at Dept. of Public Works, 285 Denton Ave.
Paul Roth, TNH. Matthew Miner, TNH.
Luz Martinez, EPA WRAM Ben Conetta, EPA NPL Coord.
2 ERM personnel, Susan Boone CDM, KSF.

ERM recently has focused mostly on N. landfill - Air sampling: ambient plus soil gas below cap plus bldg. on N.LF (Cap at NLF reportedly 4-5')
Ambient - no detect
Soil gas - trace VOCs
Bldg - trace VOCs
Development of NLF as golf course would include another application of cover.
There has been no more recent soil sampling than the SI. Also no more recent mon. well samples. Will check accessibility of wells.
This is part of Qualitative Risk Assessment. Final available in ≈2 weeks (ERM). Focus was restricted to possible problems assoc. w/ development direct contact, soil gas mainly - No GW.

John Ianone → ERM states the cap thickness at NLF is 4-5 feet, cap thickness at SLF

4/7/93 cont'd

is unknown, neither landfill has any liner, definitely.

ERM is also expecting some soil boring results - should be in any time now. May help define LF bottom depths. Some perimeter work also - they were looking to locate some stormwater dry wells outside fill boundaries.

Recharge basin: ERM believes it is more likely it is influencing LF, ie water goes from basin towards LFs rather than collecting leachate. Basin collects stormwater from local streets.
Basin is a county sump. They are currently pumping to provide more room for stormwater. ERM is not sure why this will work, since basin is groundwater (higher than GW in LF, reportedly). Not known where pump water is going.

Walking tour of South landfill. Basin is not stocked with fish, nor has any fishing occurred or occurring there, to Paul Roth's knowledge.

Tent. IDed the wells at SLF. Will go around.

1/7/93 cont'd

Drainage basin - North LF side
Basin bottom ~62 ft amsl, fill
area & local ~100 " "
Basin never totally dries up.
Info from ERM & DPW.

North LF. Viewed vent pipes at west edge.
2 rows, 1st ~20', 2nd ~7 or 8'; these (2nd)
are on back fence line of residences.

Tom will work on getting info
together to ID a possible shallow
well nearby to sample for bkg.

North landfill wells - could not locate.
DA-4 DA-5 Drove around to S.LF wells. Found both -
opened one. 2" cast iron casing. Covers
southern-most well Say "Water Meter" - flush. Inner cap
pries off. No lock.

Homes along N. edge of S. Landfill have
basements.

Spoke to Luz about deliverables. She
will send Susan format example
for prelim letter report. Discussed
various options for calculating
scores - no decision. Will see what
example looks like.

Talked to ERM - Andrea is running

4/7/93 [initials]

scope for city & has already started collecting updated GW targets - will share what they have to avoid alienating info sources. ERM has a meeting with the city this afternoon. They will see what kind of timeframe they have on finishing

[initials] scope. ERM Will send us a list of what target data they have & we will see what gaps exist. There is a sizeable area to the west that is outside Nassau County, is in Queens. Andrea states that Nassau County Public Health is a lot harder to get data from now. She is having to go thru FOIA for the well data.

(Contractual/administrative discussion obscured) [initials]

4/21/93 cont'd

South Landfill developed with park facilities. On east side near DPW Bldg and parking lot, observed excavation into side of fill - purpose unknown. LF elevated >10 ft above pkg. lot at this location, near N end of SLF. Temp. retaining wall across part of excavation (vertical). Observed cover was < 1 foot thick. Surface soil sandy, then loamy farther down. Very dark near ground surface where we were standing. Fill observed - plastic, metal, misc. debris, some concrete. North LF overgrown except cleared area in middle & informal paths/"roads" throughout.

New York State Departme of Environmental Conservation
Building #40
SUNY
Stony Brook, New York 11794

Appendix 1.1-5
Source: NCDOH

8/6/2

Peter A.A. Berle
Commissioner

REFERENCE NO. 8

December 7, 1976

To S. Jurczak
fr. JOS 3/10/
FY. Files

FP file

Commissioner Felix Andrews
Town of North Hempstead
Department of Public Works
220 Plandome Road
Manhasset, New York 11030

Dear Commissioner Andrews:

This is in reference to your letter of November 1, 1976 concerning the possible methane problems at the Town's landfills.

We understand that the Town had installed vents some years ago at the Denton Avenue Landfill to control the methane problem which was apparent at that time, and we recognize that the Town has taken measures to control that problem.

Nevertheless, on September 21, 1976, at a visit made to the Denton Avenue Site by representatives of both this Office and Nassau County Department of Health, employees of the Town of North Hempstead indicated that, in the past, the presence of methane was checked by driving a small pipe into the ground and applying a lighted match to it. It was indicated that, if methane were present, it would burn for only a few seconds. One of the Town representatives suggested that we perform a similar test by digging a similar hole in the ground. This was done at the venting trench, a portion of which caught fire and continued to burn for at least the 15 or 20 minutes during which our representatives were present despite efforts to extinguish the flames. It was necessary for one of the Town's employees to obtain a sprinkler truck in order to eliminate the fire.

As you know, that site is in an area to which the public has access. Furthermore, the trench is only a few feet away from the cyclone fence at the edge of the property. Immediately adjacent to the fence is a lumber yard, as well as a number of shops with their backyard parking lots abutting the fence.

In our opinion, this situation is a potential safety hazard to these neighboring facilities, as well as the unaware citizen who could inadvertently drop a lighted cigarette onto the flammable area referred to above.

We felt it important to bring this hazard to the Town's attention as soon as possible since we were concerned that you may not be aware of this problem, as indicated in your letter of November 1, 1976. In addition to the concern for the safety of the public, the Town could possibly be held responsible for any damages which may be attributable to the landfill.

As requested in my letter of September 27, 1976, please submit to this Office, a plan for corrective action of this problem along with a program of routine gas monitoring and surveillance. I am pleased to note that the Town will be taking gas readings on a weekly basis. This information, along with the location of the tests, should be included as part of your submittal. Please submit this information by the end of the year. Staff of this Office are available to work with you on this matter.

Very truly yours,

Donald J. Middleton
Regional Director

DJM:AM:11

cc: M. Tully, Supervisor
E. Mc Cabe
W. Cook
J. Dowling
W. Bentley
A. Machlin

REFERENCE NO. 9

Appendix 1.1
Source: NCDH

MEMORANDUM

NASSAU COUNTY DEPARTMENT OF HEALTH

240 Old Country Road - Mineola, New York 11501

To : Files

Date: Oct. 10, 1978

From : Howard Schaefer HS

Subject : Methane Complaint, Denton Ave. Landfill

A complaint was received on September 28, 1978 from Kenneth Kublo, Chief of the Garden City Park Fire Department about methane fires on the Denton Avenue Landfill.

An inspection was made of the area. Chief Kublo pointed out an area on the northern landfill, near the driving range, where the ground had cracked and where there had been a fire recently. Ornamental shrubs planted near the driving range appeared to be dying. The area near the gas vents was inspected, no odors or gas appeared to be coming from the vents.

The Garden City Park Water District located across Denton Ave. from the landfill, was visited. Several people there complained of odors from the landfill since an excavation had been made for a PBC center.

Chief Kublo called the county Fire Marshall and Fire Inspectors David Bartow and John Livingston accompanied us on a second tour of the area. Readings were taken at the point in the ground where the fire had occured as well as in the excavation for the PBC center. Most of the readings were above the lower explosive limit in the range of 7 - 10%.

HS:ms

cc: Nassau County Fire Marshall
Chief Kenneth Kublo, Garden City Park Fire Department
Gerard E. Donohue
Robert Close

REFERENCE NO. 10

Appendix 1.1

SOURCE: NCDH

MEMORANDUM

NASSAU COUNTY DEPARTMENT OF HEALTH

240 Old Country Road - Mineola, New York 11501

To : Files

Date: Oct. 10, 1978

From : Howard Schaefer HS

Subject : Follow-up Investigation of Methane Gas Complaint
Denton Ave. Landfill

A reinspection of the above site was made on October 3, 1978 by the writer, F. Pedersen, D. Aitken, along with the Fire Marshall's Office, at the request of Commissioner Cook. In addition to Commissioner Cook, Peter Vames, Clyde Perro, Jim Graham and William Boucher of the town were present.

Readings were taken in the basement of the PBC excavation by Dave Bartow (Fire Marshall's Office) and Jim Graham. Identical readings were obtained by both meters. The testing showed methane to be present in the northwest corner of the excavation. No readings were obtained in the center or southeast corner. Dave Bartow recommended that some type of venting, either external or internal, be incorporated into the building plans. Commissioner Cook stated that he would relate this to the Building Department.

Methane was also detected near the driving range as during the previous visit. No action to stop the gas was deemed necessary in this area.

HS:ms

cc: Nassau County Fire Marshall
Chief Kenneth Kublo, Garden City Park Fire Department
Gerard E. Donohue
Robert Close

REFERENCE NO. 11

Appendix 1.2

MEMORANDUM

NASSAU COUNTY DEPARTMENT OF HEALTH

240 Old Country Road - Mineola, New York 11501

To : Stanley Juczak, Jr.

Date: July 30, 1980

From : Donald Aitken, Jr.

Subject : Drainage From TNH Recreation Park (Denton Ave, Landfill).

On July 29, 1980, a survey was made of the former Denton Avenue (TNH) Landfill which has, since its closure, been developed into a Recreational Park (Swimming Pool, Golf Driving Range and Tennis and Handball Courts).

The driving range has a slight slope from west to east and water collects in a small gully which empties into the County Recharge Basin. After only four hours of moderate rain (8 a.m. to 12-noon) several areas of ponding were observed.

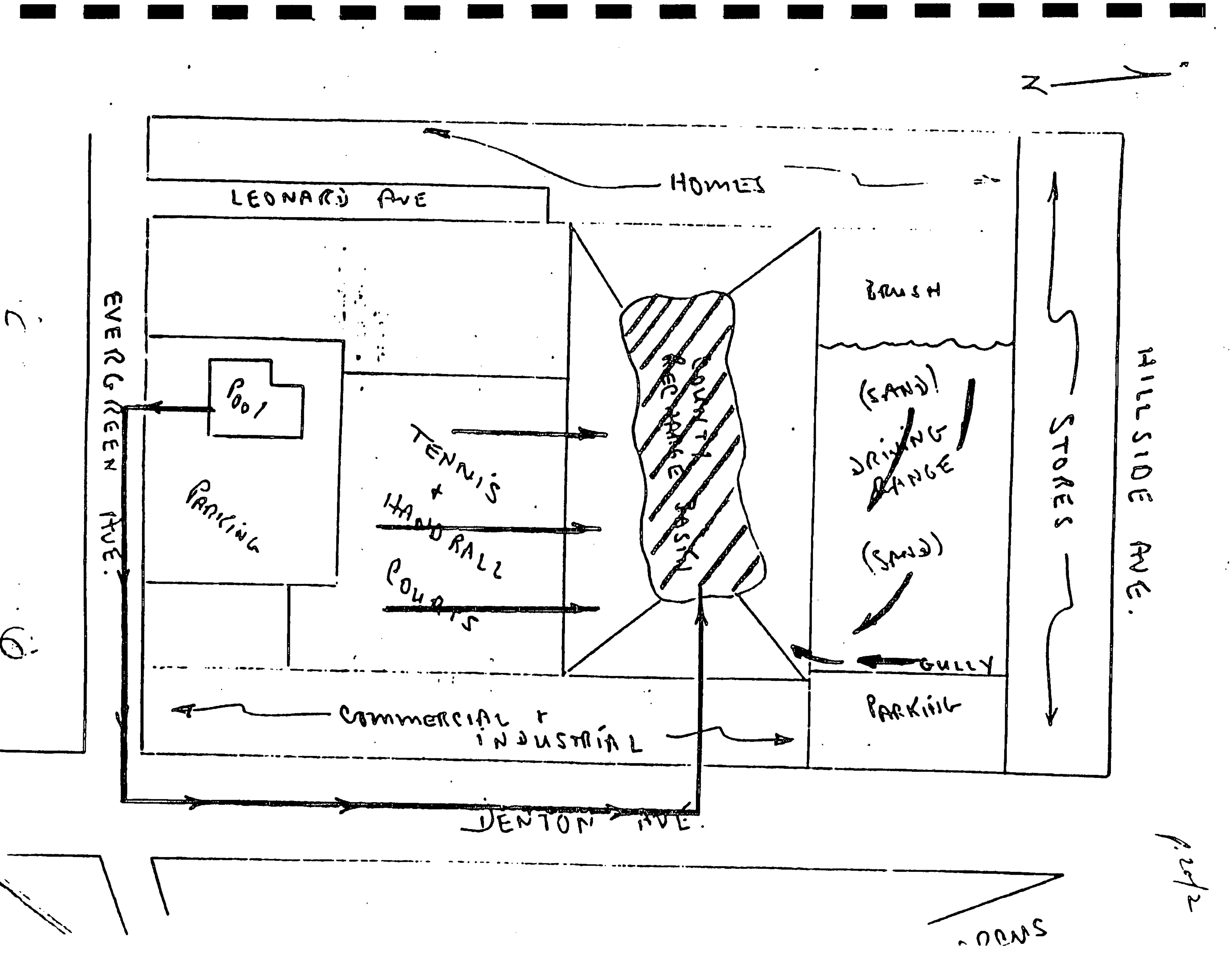
The handball and tennis courts drain directly into the recharge basin, whereas the pool complex empties into a lateral storm drain (Evergreen Avenue). This, in turn, empties into the main on Denton Avenue and the water travels north only as far as an outlet to the basin.

The map attached shows the course of the water in red with surrounding structures.

DA.

DA:ed

Attachment - Map of Denton Avenue,
New Hyde Park, N.Y.


N
HOMES
LEONARD AVE
EVERGREEN AVE.
POOL
PARKING
TENNIS + HANDBALL COURTS
COUNTY RECHARGE BASIN
BRUSH
(SAND)
DRIVING RANGE
(SAND)
GULLY
STORES
HILLSIDE AVE.
PARKING
COMMERCIAL + INDUSTRIAL
DENTON AVE.
p. 2 of 2

REFERENCE NO. 12

Appendix 1.1-3
Source: NCDoH

MEMORANDUM

NASSAU COUNTY DEPARTMENT OF HEALTH

240 Old Country Road - Mineola, New York 11501

DA — plan File

To : Files Date: May 11, 1977

From : Howard Schaefer HS

TNH - (cont) Denton Ave.

Subject : Excavation of Denton Ave. Landfill

On May 9, during a routine inspection of the Denton Ave. Incinerator a large mound of excavated refuse was noted in the park built on the southern landfill. The refuse was approximately 20 ft. high by 50 yds. long. It was composed mainly of well decomposed material with only larger wood pieces and plastic and metal material still visible. No odor, except in the area being used for dumping, was noticed. This odor was not offensive.

The area is being excavated in order to construct a swimming pool. The excavated material is to be used for backfill with the remainder being landfilled in Port Washington. Mr. Philip Wagner of Wiedersum Assoc., a subcontractor, was interviewed.

Mr. Rudy Bartoldus is the project engineer for North Hempstead. He was contacted by phone on May 10. He stated that the entire project would take approximately one year. During that time the pile of refuse would remain. After an initial portion is used for backfill the remaining pile will be dressed up and seeded until it is gradually used. The remaining material will be removed.

HS:ld

Appendix 1.1-8

NASSAU COUNTY DEPARTMENT OF HEALTH

240 OLD COUNTRY ROAD, MINEOLA, N.Y. 11501

FRANCIS T. PURCELL
County Executive

JOHN J. DOWLING, M.D., M.P.H.
Commissioner

FRANCIS V. PADAR, P.E., M.C.E.
Deputy Commissioner
Division of Environmental Health

BAQM Report No. 4E - 81

SUMMARY REPORT
VINYL CHLORIDE-AIR SAMPLING LANDFILL AREAS
TOWN OF NORTH HEMPSTEAD - DENTON AVENUE

March 4, 1981

Introduction

Events developing in Suffolk County and other communities during late 1979 and early 1980, created public health concerns relative to the emissions of vinyl chloride from previously landfilled areas and their infiltration into residential areas. While no situation related to vinyl chloride had been identified in Nassau County, public health concerns dictated that a program of air monitoring be carried out to evaluate the extent, if any, of vinyl chloride emissions from deactivated and active landfill sites.

This program was commenced on June 9, 1980, and continued through October, 1980, at which time weather conditions proved unfavorable for further monitoring operations. In that period, ten landfill locations were monitored, four of which were still in operation while the remainder were inactive and have been developed into residential areas or recreational parks and facilities. Specifically, these locations may be listed as follows:

Facilities Currently in Operation

1. Town of Hempstead facility - Merrick
2. Town of Hempstead facility - Oceanside
3. Town of Oyster Bay facility - Old Bethpage
4. Town of North Hempstead facility - Port Washington

Inactive or Developed Facilities

1. Town of North Hempstead - Denton Avenue, New Hyde Park
2. Town of Hempstead - Valley Stream
3. Town of Hempstead - Elmont Rd. Park, Elmont
4. Town of Hempstead - Averill Park, Elmont
5. Town of Hempstead - Coes Neck Rd., Baldwin
6. Town of Oyster Bay - Syosset

82415

Survey and Test Procedure

The nature of the various landfill sites that were surveyed dictated that a preliminary inspection was required to determine the most feasible and appropriate monitoring procedure to be followed. In general, however, the test sequence may be summarized as follows:

1. A cursory visual inspection was made to observe the facility boundaries, the available sampling locations,(sewers, vents, etc.) and areas most applicable for sampling (terrain, debris accumulations, etc.) From this, the candidate sampling locations would be selected and considered for instrument scanning.

2. Upon completion of the inspection, a scan was made with realtime analysis instrumentation (AID Total Hydrocarbon Analyzer and/or On-Mark Natural Gas Analyzer), to determine total hydrocarbon (THC) and methane (CH_4) levels at the various candidate sampling sites.

   The AID Total Hydrocarbon Aanlyzer (flame ionization) operates in a range of 0 to 2000 ppm (parts per million) for either total hydrocarbons or methane. It will not operate for concentrations greater than 2000 ppm.

   The On-Mark Natural Gas Analyzer (catalytic filament) operates in two ranges of 0 to 5 percent and 0 to 100 percent natural gas. The readings are less precise than the AID unit.

   The use of the instrumentation was dependent on the levels of hydrocarbon found.

3. The candidate sampling location points consist of either of the following:

   a. Sewers

   b. Existing vent outlets

   c. Holes approximately 1 in. to 1-1/2 in. diameter and 1 ft. to 2 ft. deep, penetrated by a slide hammer bang bar

   d. Ambient air at locations appropriate to the source or the receptor.

4. The sampling for the lower concentration vinyl chloride levels utilized carbon adsorption tubes or columns in conjunction with battery powered vacuum pumps. The tubes were inserted into sample location points selected on the basis of methane (natural gas) concentration and at one of the candidate sampling locations noted above. The penetration of absorption tube into the sampling point was sufficient to minimize interference effects of ground level air currents and/or other extraneous sources. The sampling time was 200 ml/min. for 25 minutes.

5. The charcoal tubes were processed by the Division of Laboratories where a gas chromatographic analysis was carried out for specific vinyl chloride content.

LANDFILL SITE: Denton Avenue DATE 7/2/80 p3of

SURVEY DATA

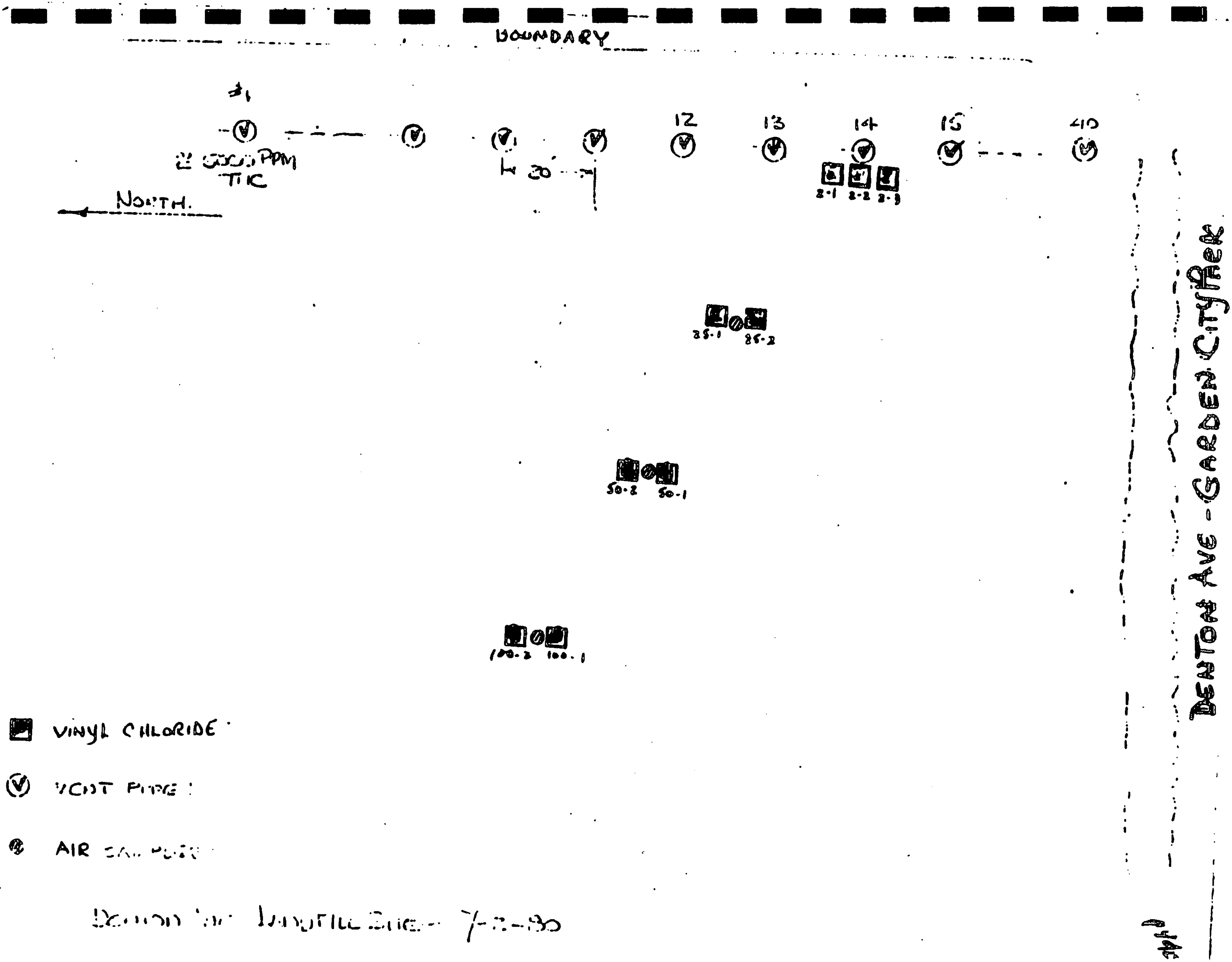
TABLE

MONITORING POINT	THC (ppm)	METHANE (ppm)	VINYL CHLORIDE (ppb)
Field Bank	-	-	None Detected
2-1	-	-	" "
2-2 & (large tube)	-	-	" "
2-3	-	-	" "
25-1	-	-	" "
25-2	-	-	" "
50-1	-	-	" "
50-2	-	-	" "
100-1	-	-	" "
100-2	-	-	" "

Comments

AID Analyzer not working - methane previously detected in ground.

None Detected means there was no vinyl chloride detected above the lowest detectably level of 38 ppb.


BOUNDARY
#1
12
13
14
15
NORTH.
2-1
2-2
2-3
25-1
25-2
50-2
50-1
100-2
100-1
VINYL CHLORIDE
AIR
DENTON AVE - GARDEN CITY PARK

p146

NASSAU COUNTY DEPARTMENT OF HEALTH
DIVISION OF LABORATORIES & RESEARCH
ENVIRONMENTAL HEALTH LABORATORIES

RESULTS OF EXAMINATION

Received from:
Nassau Co. Dept. of Health

REPORTING LAB: TRACE ORGANICS

LAB ACCESS NO. 000625

SOURCE: Denton Ave. Landfill, Field Blank

MATRIX: Air

DATE SAMPLED: 7/2/1980

DATE RECEIVED: 7/2/1980

DATE COMPLETED: [illegible]

PARAMETER	ppb (nl/l)
Vinyl Chloride	Not detected

JUL 10 1980

2790

NASSAU COUNTY DEPARTMENT OF HEALTH
DIVISION OF LABORATORIES & RESEARCH
ENVIRONMENTAL HEALTH LABORATORIES

p2015

RESULTS OF EXAMINATION

REPORTING LAB: TRACE ORGANICS

LAB ACCESS NO. 000626

SOURCE: Denton Ave. Landfill, 2-1

MATRIX: Air

DATE SAMPLED: 7/2/1980

DATE RECEIVED: 7/2/1980

DATE COMPLETED: 7/3/1980

PARAMETER	ppb (nl/l)
Vinyl Chloride	Not detected

JUL 10 1980

0626

NASSAU COUNTY DEPARTMENT OF HEALTH
DIVISION OF LABORATORIES & RESEARCH
ENVIRONMENTAL HEALTH LABORATORIES

p80/15

RESULTS OF EXAMINATION

REPORTING LAB: TRACE ORGANICS

LAB ACCESS NO. 000627

SOURCE: Denton Ave. Landfill, 2-2

MATRIX: Air

DATE SAMPLED: 7/2/1980

DATE RECEIVED: 7/2/1980

DATE COMPLETED: 7/3/1980

PARAMETER	ppb (nl/l)
Vinyl Chloride	Not detected

JUL 10 1980

0627

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P99/15

NASSAU COUNTY DEPARTMENT OF HEALTH
DIVISION OF LABORATORIES & RESEARCH
ENVIRONMENTAL HEALTH LABORATORIES

RESULTS OF EXAMINATION

REPORTING LAB: TRACE ORGANICS

LAB ACCESS NO. 000628

SOURCE: Denton Ave., Landfill, 2-3

MATRIX: Air

DATE SAMPLED: 7/2/1980

DATE RECEIVED: 7/2/1980

DATE COMPLETED: 7/3/1980

PARAMETER	ppb (nl/l)
Vinyl Chloride	Not detected

JUL 10 1980

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p 10 of 15

NASSAU COUNTY DEPARTMENT OF HEALTH
DIVISION OF LABORATORIES & RESEARCH
ENVIRONMENTAL HEALTH LABORATORIES

RESULTS OF EXAMINATION

REPORTING LAB: TRACE ORGANICS

LAB ACCESS NO. 000629

SOURCE: Denton Ave., Landfill, 25-1

MATRIX: Air

DATE SAMPLED: 7/2/1980

DATE RECEIVED: 7/2/1980

DATE COMPLETED: 7/3/1980

PARAMETER	ppb (nl/l)
Vinyl Chloride	Not detected

JUL 10 1980

8110/15

NASSAU COUNTY DEPARTMENT OF HEALTH
DIVISION OF LABORATORIES & RESEARCH
ENVIRONMENTAL HEALTH LABORATORIES

RESULTS OF EXAMINATION

REPORTING LAB: TRACE ORGANICS

LAB ACCESS NO. 000630

SOURCE: Denton Ave., Landfill, 25-2

MATRIX: Air

DATE SAMPLED: 7/2/1980

DATE RECEIVED: 7/2/1980

DATE COMPLETED: 7/3/1980

PARAMETER	ppb (nl/l)
Vinyl Chloride	Not detected

JUL 10 1980

0630

p.12 of 15

NASSAU COUNTY DEPARTMENT OF HEALTH
DIVISION OF LABORATORIES & RESEARCH
ENVIRONMENTAL HEALTH LABORATORIES

RESULTS OF EXAMINATION

REPORTING LAB: TRACE ORGANICS

LAB ACCESS NO. 000631

SOURCE: Denton Ave., Landfill, 50-1

MATRIX: Air

DATE SAMPLED: 7/2/1980

DATE RECEIVED: 7/2/1980

DATE COMPLETED: 7/3/1980

PARAMETER	ppb (nl/l)
Vinyl Chloride	Not detected

JUL 10 1980

0631

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.IVISION OF LABORATORIES & RES..RCH
ENVIRONMENTAL HEALTH LABORATORIES

p.13 of 15

RESULTS OF EXAMINATION

REPORTING LAB: TRACE ORGANICS

LAB ACCESS NO. 000632

SOURCE: Denton Ave. Landfill, 50-2

MATRIX: Air

DATE SAMPLED: 7/2/1980

DATE RECEIVED: 7/2/1980

DATE COMPLETED: 7/3/1980

PARAMETER	ppb (nl/l)
Vinyl Chloride	Not detected

JUL 10 1980

0632

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DIVISION OF LABORATORIES & RESEARCH
ENVIRONMENTAL HEALTH LABORATORIES

p.H 15

RESULTS OF EXAMINATION

REPORTING LAB: TRACE ORGANICS

LAB ACCESS NO. 000633

SOURCE: Denton Ave. Landfill, 100-1

MATRIX: Air

DATE SAMPLED: 7/2/1980

DATE RECEIVED: 7/2/1980

DATE COMPLETED: 7/3/1980

PARAMETER	ppb (nl/l)
Vinyl Chloride	Not detected

JUL 10 1980

0633

Ac.

p 15 of 15

NASSAU COUNTY DEPARTMENT OF HEALTH
DIVISION OF LABORATORIES & RESEARCH
ENVIRONMENTAL HEALTH LABORATORIES

RESULTS OF EXAMINATION

REPORTING LAB:	TRACE ORGANICS
LAB ACCESS NO.	000634
SOURCE:	Denton Ave., Landfill, 100-2
MATRIX:	Air
DATE SAMPLED:	7/2/1980
DATE RECEIVED:	7/2/1980
DATE COMPLETED:	7/3/1980

PARAMETER	ppb (nl/l)
Vinyl Chloride	Not detected

JUL 10 1980

0634

AL.

REFERENCE NO. 14

DRAFT

Qualitative Risk Assessment
Denton Avenue Landfill

March 10, 1993

Prepared For:

Town of North Hempstead
220 Plandome Road
Manhasset, NY 11030

Prepared By:

ERM-NORTHEAST
175 Froehlich Farm Boulevard
Woodbury, NY 11797

TABLE OF CONTENTS

LIST OF FIGURES

Note: All figures are included at the end of this report, following the reference section.

LIST OF TABLES

Note: All tables are included at the end of this report, following the report figures.

LIST OF APPENDICES

1.0 *INTRODUCTION*

The Town of North Hempstead (the "Town") is in the process of negotiating the sale of approximately 14 acres ("the property") of the former municipal landfill on the west side of Denton Avenue, south of Hillside Avenue in the community of New Hyde Park (Figure 1-1). The acreage to be sold is part of a 54 acre site, comprised of two separate 27 acre landfill cells separated by a Nassau County owned recharge basin. The southern 27 acre landfill was closed in 1963 and is now the site of a park and recreational complex. The northern 27 acre landfill area (which includes the 14 acres to be sold) was closed in 1974 and is currently vacant. When the sale of the 14 acres is completed, the property will be developed for use as a privately operated golf driving range. At the request of the Town, ERM-Northeast (ERM) has prepared this qualitative risk assessment for the property. The purpose of this study is to qualitatively assess potential risks to future users of the property (i.e., employees and users of the proposed development) resulting from previous use of the property as a landfill.

In order for there to be a risk, a complete exposure pathway must be present. An exposure pathway consists of: (1) a source of chemical release; (2) a transport medium/mechanism (i.e., exposure routes or pathways); and (3) a point of potential human contact (i.e., receptor or exposed population). Following development of the property as a golf driving range, there will be two potentially exposed populations: (1) landscapers and other workers employed at the property; and (2) users of the proposed development (e.g., golfers). It is assumed that use of the property by unaccompanied young children will not occur since the entire property will be fenced and in active use.

Based on available data, there are two potential pathways by which employees or users of the proposed development could be exposed to chemicals related to the landfill materials: (1) direct contact with soil at the property; and (2) inhalation of volatile organic compounds present in the vapor phase in surface soil. Generation of fugitive dust from surface soils could occur during construction activities, but is not expected to be significant following development of the property. Based on the proposed plan, the majority of the property will either be vegetated or covered with pavement or buildings, thus preventing or severely limiting any fugitive dust generation. Although chemicals related to landfill materials have been detected in groundwater and surface water (i.e., the recharge basin), these media were not evaluated in this risk assessment because there are no potential exposure pathways to employees or to users of the proposed development.

In the following sections, each of the two potential exposure pathways identified above is qualitatively evaluated based on the data presented in the NUS report (NUS, 1989) as well as data collected as part of this investigation. The potential exposure pathways were also evaluated with respect to the proposed development plans recently (February 1, 1993) submitted to the Town by Newman & Novak, architects for the developer. The drawings prepared by Newman & Novak and The Sear Brown Group (engineers for the developer) which comprise the proposed development plans are listed on Table 1-1.

Within each section, a summary of the available information is provided, followed by a comparison of data to health-based standards and criteria and a qualitative assessment of the potential risks. Potential risks are assessed in terms of the source, pathways and receptors associated with the proposed development. The remainder of this report is organized as follows:

Section 2.0: Evaluation of Potential Surface Soil Direct Contact Risks

Section 3.0: Evaluation of Potential Landfill Gas Explosion and Inhalation Risks

Section 4.0: Summary

2.0 *EVALUATION OF POTENTIAL DIRECT CONTACT RISKS*

2.1 *BACKGROUND INFORMATION*

In the 1989 NUS investigation, a total of 7 surface soil or sediment samples (0 to 6 inches) were collected from the property (S-2, S-3, S-4, S-5, S-6/S-8(Dup), S-9, and SED-2). The locations of these sampling points are shown in Figure 2-1. The samples were analyzed for inorganics, volatile organics, semivolatile organics, pesticides, and PCBs. Table 2-1 presents the analytical results for these samples. As indicated in this table, no volatile organics were detected above contract required detection limits. A number of semivolatile organics were detected, primarily in sample S-3. The relatively low concentrations of semivolatile organic compounds and inorganic constituents found in surface soil is consistent with the fact that approximately four feet of soil was used to cover the property after landfill operations had ceased (NUS, 1989).

2.2 *COMPARISON WITH CRITERIA*

In order to evaluate the soil and sediment data, the detected concentrations were compared to soil cleanup objectives provided in the NYSDEC Technical and Administrative Guidance Memorandum (TAGM) entitled "Determination of Soil Cleanup Objectives and Cleanup Levels" dated November 16, 1992. Tables 2-2 and 2-3 present this comparison for inorganic and organic compounds, respectively. Each of these tables is discussed below.

<u>Inorganics</u>

Table 2-2 compares the concentrations of inorganics detected in surface soil and sediment to the recommended soil cleanup objectives (RSCOs) developed in the NYSDEC TAGM. The RSCOs developed in the TAGM for inorganics are based on site background values, where available, or regional background values. (No site background data was available for the property). As shown in Table 2-2, the maximum detected concentrations of aluminum, arsenic, calcium, and manganese are all below their respective RSCOs. Although one or more samples had concentrations of chromium and iron in excess of the applicable RSCOs, the maximum concentrations of these chemicals were, nevertheless, within the range of typical background concentrations listed in the TAGM (1.5-40 mg/kg for chromium and 2,000-550,000 mg/kg for iron).

Of the remaining chemicals, all but zinc were detected in only one sample in excess of the RSCO. In order to further evaluate these chemicals, acceptable health-based levels were derived using the direct contact exposure assumptions used by NYSDEC in developing RSCOs for organic compounds. These exposure assumptions are based on a 16 kg (35 lb) child consuming 200 mg of soil per day for a total of five years. It should be noted that this exposure rate is in all likelihood greater than any exposures which would actually be incurred at the property. As previously stated, it is assumed that use of the property by unaccompanied young children will not occur since the entire property will be fenced and in active use. In addition, the proposed development plans call for all areas of the property to be paved or landscaped. The majority of the property, i.e., the golf driving range, would not be accessible to users of the property after it is developed. Therefore, the acceptable levels derived based on the aforementioned NYSDEC exposure assumptions are expected to be fully protective of the adult employees and other individuals using the developed property.

As shown in Table 2-2, the maximum detected concentrations of cadmium, nickel, vanadium, and zinc are all below the health-based acceptable cleanup levels. Lead cannot be evaluated in this manner because the USEPA has not currently approved an oral reference dose or potency factor. However, the maximum detected concentration of lead of 287 ppm is below the current

USEPA recommended soil cleanup level for lead in residential areas of 500-1,000 ppm (USEPA, 1989).

Organic Compounds

Table 2-3 compares the range of concentrations of organic compounds detected in soil to the NYSDEC cleanup objectives based on direct contact with soil (where available). For organic compounds, the NYSDEC TAGM developed two sets of cleanup objectives for soil. One set of cleanup objectives is based on protection of groundwater from chemicals leaching from soil. The second set of cleanup objectives is based on direct contact with soil. The lower of these two cleanup objectives is then selected as the RSCO. Since the purpose of this evaluation is to address risks posed by people using the property following its development as a driving range, the cleanup objectives based on direct contact are most appropriate for use in evaluating this data. Consequently, the NYSDEC cleanup objectives based on potential direct contact exposures were used in this qualitative risk assessment.

As shown in Table 2-3, the maximum detected concentrations of all organics detected at the property except benzo(a)anthracene and benzo(a)pyrene are below their respective cleanup objectives for direct contact exposures. Benzo(a)anthracene and benzo(a)pyrene were each detected above the contract required detected limit (CRDL) in only one sample (i.e., sample S-3). The location of sample S-3 is along the western perimeter of the property, adjacent to or possibly slightly within the golf driving range area itself. This area will be enclosed along its western, northern and eastern boundary within a fence extending to a height of 40 feet except in some areas, where the fence will be extended to a height of sixty feet. The area will be enclosed along its southern boundary by the two level golf tee booths. For safety and operational reasons, access to the golf driving range area will be limited to facility workers only. Physically, the only access to the area will be through a gate from the fenced maintenance area located in the southwest corner of the property.

2.3 *ASSESSMENT OF RISK*

Based on information presented in the NUS report, use of the property as a golf driving range is not expected to result in any significant adverse impacts to human health due to direct contact with soil. The basis for this conclusion is summarized below.

(1) Following development of the property, there will be limited opportunity or reason for direct contact with soil. Most of the property will be paved or vegetated. The entire property will be fenced, thus preventing unsupervised access by young children.

(2) The area with the highest concentration of chemicals that appear to be related to the previous use of the property (i.e., sample S-3) is in an area that will be developed as a relatively inaccessible part of the golf driving range.

(3) Although elevated concentrations of metals and some semivolatile organics were detected, the concentrations were in most cases below background or health-based acceptable levels. The concentrations of only two chemicals, benzo(a)pyrene and benzo(a)anthracene, exceed the acceptable levels and in only one sample (i.e., sample S-3). As previously stated, this sample is located in an area that will not be accessible to users of the proposed development. In addition, the site-wide average concentrations of these chemicals, which are more representative of potential risks that may be posed by chemicals in soil, do not exceed acceptable levels.

Surface soil at the property, even under existing (i.e., pre-development) conditions, does not pose unacceptable human health risks. In addition, the proposed development includes measures to cover the property with pavement, buildings and landscaped areas. As a result, direct contact with existing surface soil by users of the proposed development will be limited or non-existent. The limited presence of chemicals in surface soil (i.e., limited source areas) and the limited and perhaps non-existent direct contact pathways resulting after development eliminate direct contact with surface soil as a potential risk.

3.0 *EVALUATION OF POTENTIAL LANDFILL GAS EXPLOSION AND INHALATION RISKS*

In addition to direct contact with surface soil (discussed in Section 2.0), the second pathway by which employees or users of the proposed development could be exposed to chemicals at the property is by inhalation of chemicals of concern in landfill gas. Chemicals of concern in landfill gas include methane, which is generated in the landfill, and other volatile organics, which may have been placed with waste materials during previous landfill operations. In addition, the accumulation of methane gas in enclosed spaces can present potential fire or explosion risks. This section discusses: (1) the results of previous and recent landfill gas sampling (Section 3.1); (2) a comparison of the recent landfill gas sampling results to standards (Section 3.2); and (3) an assessment of the potential landfill gas explosion and inhalation risks (Section 3.3).

3.1 *RESULTS OF LANDFILL GAS SAMPLING*

Landfill gas and ambient air have previously been sampled by the Nassau County Department of Health (NCDOH) and by the NUS Corporation. The NUS sampling was performed as part of the site inspection field work performed by NUS for the USEPA. Previous landfill gas sampling results are discussed in Section 3.1.1. Recent (i.e., January and February 1993) sampling of landfill gas and ambient air performed by ERM for the Town is discussed in Section 3.1.2.

3.1.1 *Previous Sampling Results*

Soil gas and/or ambient air at the property has been sampled on three previous occasions by the NCDOH and NUS. A summary of these sampling results is provided below.

In 1976, NCDOH collected gas samples to be used in evaluating the effectiveness of the on-site venting system. The samples were collected from the ground and were found to have concentrations of methane at three locations at levels exceeding the lower explosive limit, or LEL (NUS, 1989). In 1980, NCDOH collected 10 air samples from the property to be analyzed for vinyl chloride. Vinyl chloride was not detected in any of these samples (NUS, 1989).

During the NUS USEPA Region 2 Field Investigation Team site reconnaissance conducted in 1989, Organic Vapor Analyzer flame ionization detector (OVA) and HNu photoionization detector (HNu) measurements were taken at various locations at the property (NUS, 1989). The results are summarized in Table 3-1. The OVA readings include the concentration of methane in the gas sampled by this instrument. Conversely, the HNu readings do not include the concentration of methane and are more representative of the possible presence of volatile organic compounds. As shown in this table, OVA readings ranged from 0 to >1,000 ppm. The highest OVA readings were taken in the vicinity of SW/SED-1 and S-7. Subsequent screening of this area using Draeger tubes, which measure the concentration of selected individual volatile organic compounds, did not reveal the presence of benzene or vinyl chloride in the ambient air. The highest OVA reading detected elsewhere on the property was 10 ppm. HNu readings were detected near the ground at three locations in the vicinity of the vent pipes. The highest HNu reading was 20 ppm above background.

3.1.2 Recent Sampling Results

In order to further evaluate potential exposures via the air pathway, a methane survey and a volatile organics survey of the property were conducted by ERM in January and February 1993 as part of this investigation. A summary of the results is provided below.

In the methane survey, soil gas at a depth of 5 feet at a total of 22 sample locations throughout the property was monitored using: (1) a combustible gas meter to determine the percent lower explosive limit (LEL) and resultant methane concentration; and (2) a photo-ionization detector (PID) to identify the presence, if any, of non-methane volatile organics. The results are summarized in Table 3-2. As indicated in this table, the predominant constituent of soil gas at the property is methane. The percent of LEL readings ranged from 0 to 100 percent, with approximately one-half of the sampling locations having 100 percent LEL readings. The LEL of methane occurs when methane concentrations represent approximately 5.3 percent of the gas sample. Therefore, concentrations of methane in soil gas at these sampling points (i.e., 100 percent LEL) are expected to be at least 5.3 percent.

In the volatile organics survey, two samples were collected from soil gas located five feet below the surface of the property and one sample was collected from ambient air. These samples were analyzed for individual volatile organic compounds. Two samples (ERM-S2 and ERM-S3) measured soil gas within the landfill itself. The sampling locations were selected based on the locations with the highest PID readings in the methane survey. Sample ERM-S2 was collected from the proposed golf booth area and sample ERM-S3 was taken along the northern fence at the property boundary. The fourth sample (ERM-S4) measured ambient air in the breathing zone near the center of the landfill. Analytical results are provided in Table 3-3. As shown in this table, no volatile organics were detected in the ambient air sample.

3.2 COMPARISON WITH CRITERIA

In this section, the data collected as part of the recent ERM investigation are evaluated with respect to applicable standards and criteria. The results of the methane survey are discussed first, followed by a discussion of the results of the volatile organics survey.

3.2.1 *Methane Survey*

In general, there are two concerns associated with methane. The first concern is the possibility of explosion or fire, and the second concern is health effects associated with inhalation of methane. Each of these is discussed below.

The risk of an explosion or fire is measured by the percent LEL reading. As shown in Table 3-2, approximately one-half of the soil gas samples taken had LEL readings of 100 percent. It should be noted that these measurements represent conditions in soil gas in the landfill, not ambient air. Following dilution in the ambient air, the concentrations in air to which people may be exposed will be considerably lower. Nevertheless, the results indicate that methane is present in landfill gas in concentrations exceeding the LEL. As a result, an explosive condition or fire could result if landfill gas is permitted to migrate to and accumulate in enclosed spaces and if an ignition source is present. These conditions are not present at the property in its current state; that is, there are no enclosed spaces or ignition sources at the property.

The enclosed spaces to be constructed as part of the proposed development plans include manholes and buildings. A total of four buildings are proposed for construction at the property: (1) golf tee booths (two levels); (2) a golf pro shop, including a snack bar; (3) a miniature golf booth; and (4) a maintenance building. Manholes are to be constructed as part of the storm water and sanitary waste water sewer lines. Occupational Safety and Health Administration (OSHA) regulations require that, prior to entry, confined spaces such as storm water or sanitary waste water manholes be monitored. Manholes must be monitored for asphyxiant, toxic or explosive gases that can be generated by debris from storm water or sanitary waste water, even if external sources of methane and other gases, such as landfill gas, are not present. The OSHA regulation require that protective measures such as respirators or external air supply be used if required based on the pre-entry monitoring results.

The proposed development must be designed so as to prevent the migration or the accumulation of landfill gas in either manholes or buildings. Relatively simple methods can be used in the design and construction of these structures to ensure that explosive or fire conditions related to the presence of methane in landfill gas do not occur in enclosed spaces. The Town has contracted with ERM to review the final submission of the proposed development plans to determine whether these plans address environmental issues related to the property. As part of this review, ERM will evaluate whether adequate measures have been included in the proposed development plans to prevent landfill gas from migrating into or accumulating in enclosed spaces. If these measures are included in the proposed development plans, the potential pathway for landfill gas containing methane in concentrations above the LEL to migrate into or accumulate in enclosed spaces will be prevented. These measures will be required by the Town prior to development of the property. If the procedures established by the Town to ensure that these preventive measures are incorporated into the proposed development are implemented, potential fire or explosion hazards related to the presence of methane in landfill gas will not occur.

With respect to health effects, methane is classified as a simple asphyxiant gas. Gases of this type have no specific toxicity effect, but they act by excluding oxygen from the lungs. As described in "Dangerous Properties of Industrial Materials" (Sax, 1979):

> The effect of simple asphyxiant gases is proportional to the extent to which they diminish the amount (partial pressure) of

oxygen in the air that is breathed. The oxygen may be diminished to 2/3 of its normal percentage in air before appreciable symptoms develop, and this in turn requires the presence of a simple asphyxiant in a concentration of 33% in the mixture of air and gas.

As shown in Table 3-2 and discussed above, approximately one-half of the soil gas samples taken had LEL levels of 100 percent and, therefore, expected concentrations of methane of 5.3 percent or higher. These measures represent the concentration of methane in soil gas located approximately five feet beneath the surface of the property. In order for the methane in landfill gas in soil at this depth to present a potential human health risk (i.e., by displacing oxygen and thus reducing oxygen concentrations to levels that pose potential asphyxiant risks), methane in landfill gas must migrate to and accumulate in enclosed spaces. As discussed above (Section 3.2.1) with respect to fire and explosion hazards related to methane, procedures have been established to ensure that measures to prevent migration and accumulation of landfill gas in enclosed spaces (i.e., manholes and buildings) are included as part of the proposed development. If the procedures established by the Town to ensure that these preventive measures are incorporated into the proposed development are implemented, potential human health risks related to the presence of methane in landfill gas will not occur.

3.2.2 *Volatile Organics Survey*

In order to evaluate potential impacts to employees and users of the proposed development, the volatile organics survey results were compared to applicable federal and New York State standards and guidelines. To assess potential impacts to employees, the detected concentrations are compared to the OSHA Permissible Exposure Limits (PELs). The OSHA PELs are enforceable standards developed to protect workers and are based on a 40-hour work week exposure period. In order to evaluate potential impacts to users of the proposed development, a modification to the NYSDEC Ambient Guideline Concentrations (AGCs) was calculated. The AGC is a health-based acceptable concentration to which an individual may be exposed 24 hours per day, 365 days per year for an entire lifetime. Individual users of the developed property (e.g., golfers) are only expected to be at the property for a fraction of this time. It was conservatively assumed that an individual user would be present at the property for a maximum of four hours per day, three days per week, 48 weeks per year, or 6.6 percent of the year. Therefore, an approximate acceptable ambient concentration for these receptors was derived by dividing the 24-hour AGC by 0.066. Both the PELs and the derived acceptable concentrations are presented in Table 3-3.

As shown in Table 3-3, the concentrations of individual volatile organics in soil gas in samples ERM-S2 and ERM-S3 are all well below the applicable OSHA PELs and, except for tetrachloroethene and 1,1-dichloroethene, are below the derived acceptable ambient concentration. Following dilution in air, it is expected that the concentration of tetrachloroethene and 1,1-dichloroethene in ambient air in the vicinity of these samples would be below the acceptable concentration. This conclusion is supported by the fact that the ambient air sample collected as part of this study (ERM-S4) did not have detectable concentrations of any organic compounds.

However, due to the concentrations of tetrachloroethene and 1,1-dichloroethene in landfill gas samples, volatile organics in soil gas five feet beneath the surface of the property constitute a source of potential human health risks. In order for this risk to be defined, an exposure route, or pathway, for volatile organics in landfill gas must be present. There are no enclosed spaces at the property at the present time. As a result, there are no potential human health risks associated with volatile organics in landfill gas under current conditions.

Enclosed spaces are included in the proposed development. As discussed in Section 3.2.1 for methane, landfill gas must migrate into and accumulate in enclosed spaces, such as the manholes and buildings included in the proposed development plans, in order for chemicals in landfill gas to pose a potential human health risk. Under future conditions, then, manholes and buildings proposed in the development plans could provide potential exposure routes for volatile organics to workers and users of the proposed development. The only potential receptors to volatile organics that may accumulate in manholes are facility and utility workers. Since the concentration of volatile organics in landfill gas are below the OSHA PELs, the entry of facility or utility workers into manholes would not pose unacceptable human health risks. In addition, OSHA regulation require that confined spaces such as manholes be monitored prior to entry and that protective measures such as respirators or external air supplies by used if required based on the pre-entry monitoring results.

Unless properly designed and constructed, landfill gas can also enter into and accumulate in the buildings proposed in the development plans. Potential receptors to volatile organics in buildings include workers and users of the proposed development. As discussed in Section 3.2.1, procedures have been established to ensure that measures to prevent migration and accumulation of landfill gas in enclosed spaces, including buildings, are included as part of the proposed development. If these procedures are implemented, potential human health risks related to the presence of volatile organics in landfill gas will not occur.

3.3 *ASSESSMENT OF RISK*

Potential risks related to landfill gas include potential fire and explosion hazards related to methane and potential human health risks related to the presence of volatile organics. These risks require that landfill gas migrate into and accumulate in enclosed spaces. There are no enclosed spaces at the property at the present time. As a result, there are no potential human health, fire and explosion risks associated with methane and volatile organics in landfill gas under current conditions.

Under future conditions, manholes and buildings proposed for development provide enclosed spaces whereby landfill gas can accumulate. Recent methane monitoring and VOC sampling indicates that: (1) the concentration of volatile organics present in landfill gas do not pose unacceptable human health risks to workers; (2) manholes require protective measures to address potential fire and explosive hazards; and (3) buildings require protective measures to address potential fire and explosion risks and potential human health risks to users of the proposed development. Relatively simple measures can be included in the design and construction of these structures to prevent landfill gas from migrating into and accumulating in manholes and buildings. As discussed in Section 3.2.1, the Town has established procedures to ensure that measures to prevent landfill gas migration and accumulation in enclosed spaces be incorporated in the design and construction of the proposed development. If preventive measures are properly designed and constructed in accordance with these procedures, potential fire and explosion hazards and potential human health risks related to landfill gas will not occur.

4.0 SUMMARY AND CONCLUSIONS

The purpose of this study is to qualitatively assess potential risks to future users of the property resulting from previous use of the property as a landfill. Based on available information, use of the property as a golf driving range as currently planned is not expected to result in any significant adverse impacts to human health as a result of direct contact with soil. Surface soil at the property, even under existing (i.e., pre-development) conditions, does not pose unacceptable human health risks. In addition, the proposed development includes measures to cover the property with pavement, buildings and landscaped areas. As a result, direct contact with existing surface soil by users of the proposed development will be limited or non-existent. The limited presence of chemicals in surface soil (i.e., limited source areas) and the limited and perhaps non-existent direct contact pathways resulting after development eliminate direct contact with surface soil as a potential risk.

Potential risks related to landfill gas include potential fire and explosion hazards related to methane and potential human health risks related to the presence of volatile organics. These risks require that landfill gas migrate into and accumulate in enclosed spaces. There are no enclosed spaces at the property at the present time. As a result, there are no potential human health, fire and explosion risks associated with methane and volatile organics in landfill gas under current conditions.

Under future conditions, manholes and buildings proposed for development provide enclosed spaces whereby landfill gas can accumulate. Recent methane monitoring and VOC sampling indicates that: (1) the concentration of volatile organics present in landfill gas do not pose unacceptable human health risks to workers; (2) manholes require protective measures to address potential fire and explosion hazards; and (3) buildings require protective measures to address potential fire and explosion risks and potential human health risks to users of the proposed development. The Town has established procedures to ensure that measures to prevent landfill gas migration and accumulation in enclosed spaces be incorporated in the design and construction of the proposed development. If preventive measures are properly designed and constructed in accordance with these procedures, potential fire and explosion hazards and potential human health risks related to landfill gas will not occur.

LIST OF REFERENCES

NUS Corporation, 1989. Final Draft Site Inspection Report, Denton Avenue Landfill, New Hyde Park, New York. September 20, 1989.

NYSDEC, 1992. Division Technical and Administrative Guidance Memorandum: Determination of Soil Cleanup Objectives and Cleanup Levels. November 16, 1992.

Sax, N.I., 1979. Dangerous Properties of Industrial Materials. Fifth Edition. Van Nostrand Reinhold Company.

USEPA, 1989. OSWER Directive #9355.4-02 - Interim Guidance on Establishing Soil Lead Cleanup Levels at Superfund Sites. September 7, 1989.

TABLES

TABLE 1-1

PROPOSED DEVELOPMENT PLAN
LIST OF DRAWINGS[1]

DENTON AVENUE LANDFILL
("SPRING ROCK GOLF CENTER")
NEW HYDE PARK, NY

Drawing Nº.	Title	Prepared by[2]	Date[3]
SP-1	Site Plan	Newman & Novak	2-5-93
A-1	Pro Shop Elevation	Newman & Novak	none
A-2	Roof Plan	Newman & Novak	1-15-93
none	Site Plan	The Sear-Brown Group	2-5-93
SE-1	Site Plan	The Sear-Brown Group	2-4-93
SE-2	Grading and Drainage Plan	The Sear-Brown Group	2-4-93
SE-3	Lighting Plan	The Sear-Brown Group	2-4-93
Se-4	Site Construction Details	The Sear-Brown Group	2-4-93
L-1	Site Planting Plan	Newman & Novak	2-8-93
L-2	Landscape Plan	Newman & Novak	2-8-93

Notes:

1. List of drawings transmitted by Newman & Novak to ERM for review of environmental conditions. Received by ERM February 16, 1993.

2. Architects:

   Newman & Novak
   Architects, P.C.
   395 North Service Road
   Melville, N.Y. 11747

   Design Engineers:

   The Sear-Brown Group
   2300 Marcus Avenue
   Lake Success, N.Y. 11042

3. Date originally prepared or date of last revision, whichever is later.

TABLE 2-1
SUMMARY OF NUS SOIL/SEDIMENT SAMPLING RESULTS
FOR THE PROPERTY (1)
Page 1 of 3

Compounds Present	S2	S3	S4	S5 (MS/MSD)	S6	S8 (DUP)	S9	SED-2
INORGANICS (mg/kg)								
Aluminum	2,840	11,900	4,550	2,090	1,730	1,640	3,410	3,930
Arsenic	5.3	5	4.4	3.3	3.3	3	4.2	J
Cadmium		1.7 E						
Calcium	J	J	7,280	1,370	J	1230	J	J
Chromium	12.5	19.2	6.8 E	5.4 E	2.7 E	4.9 E	10.7	12.7
Iron	8,610	13,900	9,940	4,740	4,210	4,280	8,250	7,330
Lead	48.5	287	56.7	28.3	23.3	21.9	51.8	43.3
Magnesium	J	J	J	J	J	J	J	J
Manganese	80.5	118	331	113	72.7	73.9	129	89.4
Nickel	J	32.3 E	J	J	J	J	9.2 E	11.1E
Vanadium	J	445 E	J	J	J	J	14.2 E	J
Zinc	99.1 E	6700 E	70.4 E	29.6 E	25.7 E	27.5 E	28.3 E	35.8E

All notes for Table 2-1 are listed on page 3 of 3

TABLE 2-1
SUMMARY OF NUS SOIL/SEDIMENT SAMPLING RESULTS
FOR THE PROPERTY (1)

Compounds Present	S2	S3	S4	S5 (MS/MSD)	S6	S8 (DUP)	S9	SED-2
SEMIVOLATILES (ug/kg)								
1,4-Dichlorobenzene								
Bis(2-chloroisopropyl)ether		R	R	R	R	R	R	
4-Methylphenol			J					
Benzoic Acid	R	J	J	J	J			
Naphthalene		J						
2-Methylnaphthalene	J							
Acenaphthene		J						
Dibenzofuran	J							
Fluorene	J							
Phenanthrene	J	610	J	J	J		J	
Anthracene		J						
Di-n-butylphthalate		J					J	
Fluoranthene	J	2,500	J	J	J	J	J	
Pyrene	820 E	3,300	J	J	J	J	J	
Butylbenzylphthalate				J	J			
Benzo(a)anthracene		1,700	J	J	J	J	J	
Chrysene		1,800	J	J	J	J	J	
Bis(2-ethylhexyl)phthalate		1,800						
Benzo(b)fluoranthene	670 E	3,300 E	J	J	J	J	J	
Benzo(k)fluoranthene	670 E	2,000 E	J	J	J	J	J	
Benzo(a)pyrene	J	1,800 E	J	J	J	J	J	
Indeno(1,2,3-cd)pyrene	J	740 E	J	J	J			
Dibenz(a,h)anthracene	J	J						
Benzo(g,h,i)perylene	J		J		J			

All notes for Table 2-1 are listed on page 3 of 3

TABLE 2-1
SUMMARY OF NUS SOIL/SEDIMENT SAMPLING RESULTS
FOR THE PROPERTY (1)

Compounds Present	S2	S3	S4	S5 (MS/MSD)	S6	S8 (DUP)	S9	SED-2
PESTICIDES (ug/kg)								
Dieldrin		28						
4,4'-DDE		42						
4,4'-DDD		47						
Aroclor-1254	440	390						
Aroclor-1260								210

Notes:
E - Estimated value
J - Estimated Value; compound present below CRDL but above IDL
R - Analysis did not pass EPA QA/QC
Blanks indicate non-detect
(1) Only chemicals detected above CRDL in one or more samples are included.

TABLE 2-2
COMPARISON OF CONCENTRATIONS OF CHEMICALS IN SURFACE SOIL/SEDIMENT TO ACCEPTABLE LEVELS (INORGANICS)

Chemical	Range of Detected Concentrations (mg/kg)	Recommended Soil Cleanup Objective[1] (mg/kg)	Health-Based Acceptable Level - Direct Contact[2] (mg/kg)
Aluminum	1,640-11,900	33,000	--
Arsenic	3-5.3	7.5	--
Cadmium	BDL-1.7	1	80
Calcium	BDL-7,280	130-35,000	--
Chromium	2.7-19.2	10	--
Iron	4,210-13,900	2,000	--
Lead	21.9-287	30	500-1,000[3]
Manganese	72.7-331	50-5,000	--
Nickel	BDL-32.3	13	1,600
Vanadium	BDL-445	150	560
Zinc	25.7-6,700	20	16,000

(1) Source: NYSDEC, 1992
(2) Derived using methodology described in NYSDEC, 1992, except as noted. See Appendix A.
(3) Source: USEPA, 1989.

TABLE 2-3
COMPARISON OF CONCENTRATIONS OF CHEMICALS
IN SURFACE SOIL/SEDIMENT
TO ACCEPTABLE LEVELS
(Organics)

Chemical	Range of Detected Concentrations (ug/kg)	Cleanup Objective Based on Direct Contact (1) (ug/kg)
Semivolatile Organics		
Phenanthrene	ND-610	50,000 (2)
Fluoranthene	ND-1500	50,000 (2)
Pyrene	ND-3300	50,000 (2)
Benzo(a)anthracene	ND-1700	220
Chrysene	ND-1800	NA
Bis(2-ethylhexyl)phthalate	ND-1800	50,000
Benzo(b)flouranthene	ND-3300	NA
Benzo(k)flouranthene	ND-2,000E	NA
Benzo(a)pyrene	ND-1,800E	61
Indeno(1,2,3-cd)pyrene	ND-740E	NA
Pesticides/PCBs		
Dieldrin	ND-28	44
4,4'-DDE	ND-42	2,100
4,4'-DDD	ND-47	2,900
PCB-1254	ND-440	1,000

Notes:

NA: Not Available
(1) Source: NYSDEC, 1992
(2) Recommended soil cleanup objective for individual semivolatile organic compounds.

TABLE 3-1
SUMMARY OF OVA AND HNU MONITORING AT
THE PROPERTY DURING THE NUS INVESTIGATION (1)

Date	Time	Location	OVA (ppm)	HNu (ppm)	Methane Flush Test	Mini Rad (cpm)
6-Jun-89	7:40	Background	0	0		11
6-Jun-89	12:14	50' W of vents 13 & 14.	0	0		
6-Jun-89	12:19	Pipe branch of N/S metal pipe	5		Positive	
6-Jun-89	12:20	Former DA-3/DA-4 well location	0	3.6		
6-Jun-89	12:20	Breathing zone	0	0		
6-Jun-89	12:30	Former DA-2 location - 45' NE of W border of site at venting pipes 21 & 22	9	20		
6-Jun-89	12:30	Breathing zone	0	0		
6-Jun-89	12:34	Oily stain 40' from vent 17	0	4		
6-Jun-89	12:36	Crushed pail E of vent 14	30		Possible	
14-Jun-89	11:19	Sample location SW/SED-2	1.5	0		
14-Jun-89	12:06	Sediments at SED-2	2	0		
14-Jun-89	12:32	Soil sample location S-2	0	0		
14-Jun-89	15:20	Soil sample location S-4	9-10	0		
14-Jun-89	16:05	Soil sample location S-6/S-8	0	0		
14-Jun-89	17:15	Samples SW/SED-1, S-7, in breathing zone, vicinity of drainage pathway	50-70	0		
14-Jun-89	17:20	SW/SED-1, S-7 vicinity	10-14	0	Negative	
14-Jun-89	17:55	Top of hill	50-60			
14-Jun-89	18:24	Drainage pathway	4-6			
14-Jun-89	18:47	Near Top of Hill	>1,000	0		

Notes:
OVA - Organic Vapor Analyzer - Flame Ionization Detector
HNu - Photoionization detector
Mini-Rad - Mini Radiation Alert
ppm - parts per million
cpm - counts per minute
Blanks indicate data not recorded
(1) Compiled from field notes in NUS report.

TABLE 3-2
RESULTS OF METHANE SURVEY (1)

Location	TVOC PID (ppm)	% of LEL
A	0.0	5
B	0.3	100
C	5.2	70
D	0.6	100
E	2.0	0
F	0.2	24
G	0.4	17
H	0.3	33
I	0.1	100
J	6.2	12
K	5.0	19
L	1.1	100
M	0.0	100
N	1.4	100
O	0.1	100
P	0.0	0
Q	0.0	0
R	1.7	55
S	3.4	100
T	0.0	100
U	0.6	100
V	0.3	100

All samples collected at a depth of 5 feet.
TVOC: Total concentration of volatile organic compounds excluding methane as measured by a PID.
LEL: Lower Explosive Limit

TABLE 3-3
COMPARISON OF VOLATILE ORGANIC SURVEY RESULTS TO APPLICABLE STANDARDS AND CRITERIA

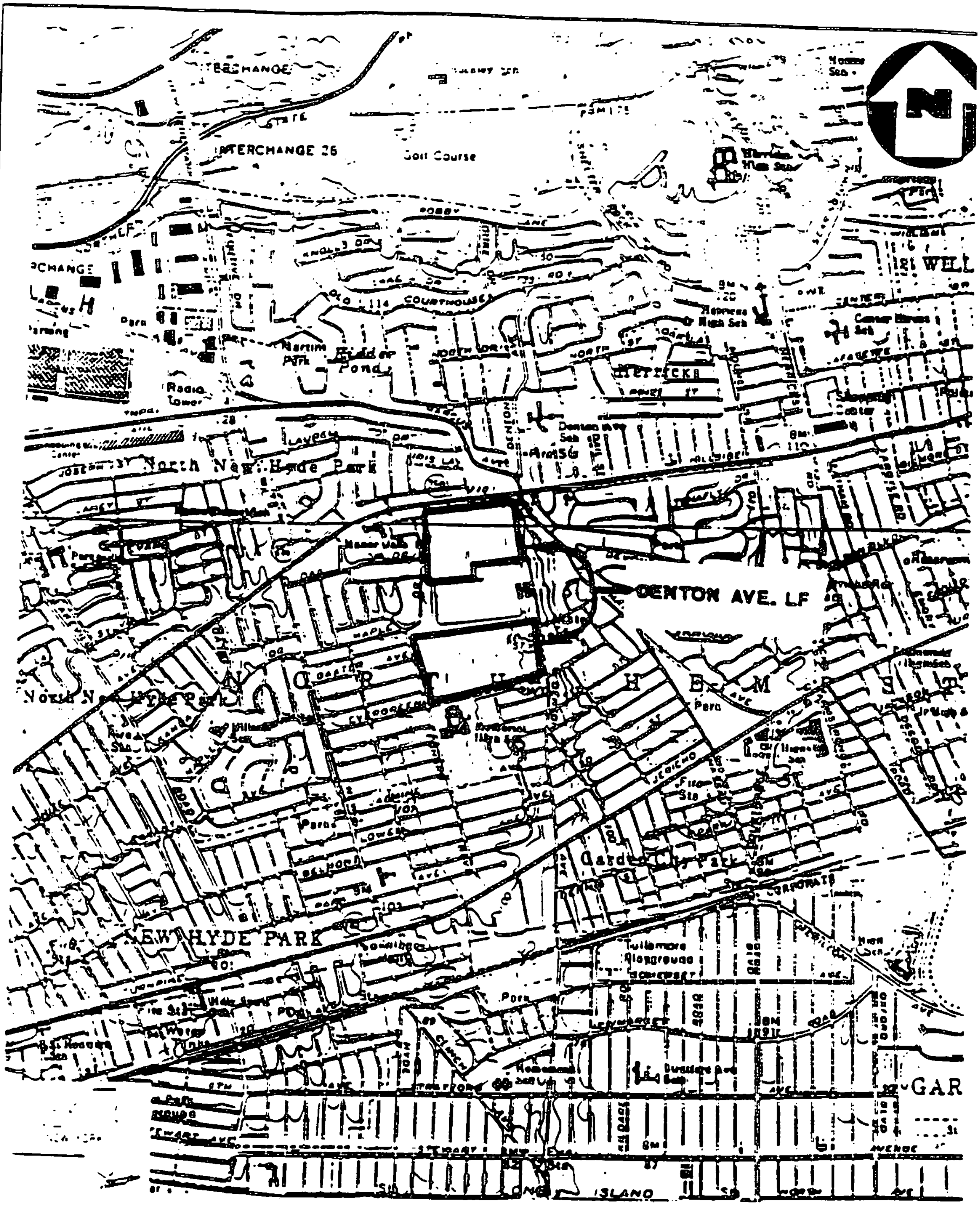
	SOIL GAS SAMPLE (ug/m^3)				
Chemical	ERM-S2 (Golf Booth Area)	ERM-S3 (North Fence)	ERM-S4 (Ambient Air)	PEL TWA (ug/m^3)	Derived Acceptable Concentration for Users of the Development[1] (ug/m^3)
Trichloroethene	6	5.11	--	270,000	6.8
Toluene	317	42.61	--	375,000	30,400
Tetrachloroethene	17	31.25	--	170,000	1.14
Ethylbenzene	131	--	--	435,000	15,200
m,p-Xylene	341	--	--	435,000	4,560
o-Xylene	205	--	--	435,000	4,560
Methylene chloride	25	2.84	--	353,000	410
Chloroform	8	--	--	9,780	350
1,1,1-Trichloroethane	2	62.50	--	1,900,000	15,200
1,1-Dichloroethene	--	11.36	--	4,000	0.30

Notes:

-- Indicates compound not detected.

(1) Based on a modification of the AGC. See Section 3.2.2

FIGURES



(QUAD) SEA CLIFF, N.Y.

Source: Figure 1; *Final Draft Site Inspection Report, Denton Avenue Landfill, New Hyde Park, New York*; NUS Corporation; September 20, 1989

SCALE: 1"=2000'

TITLE

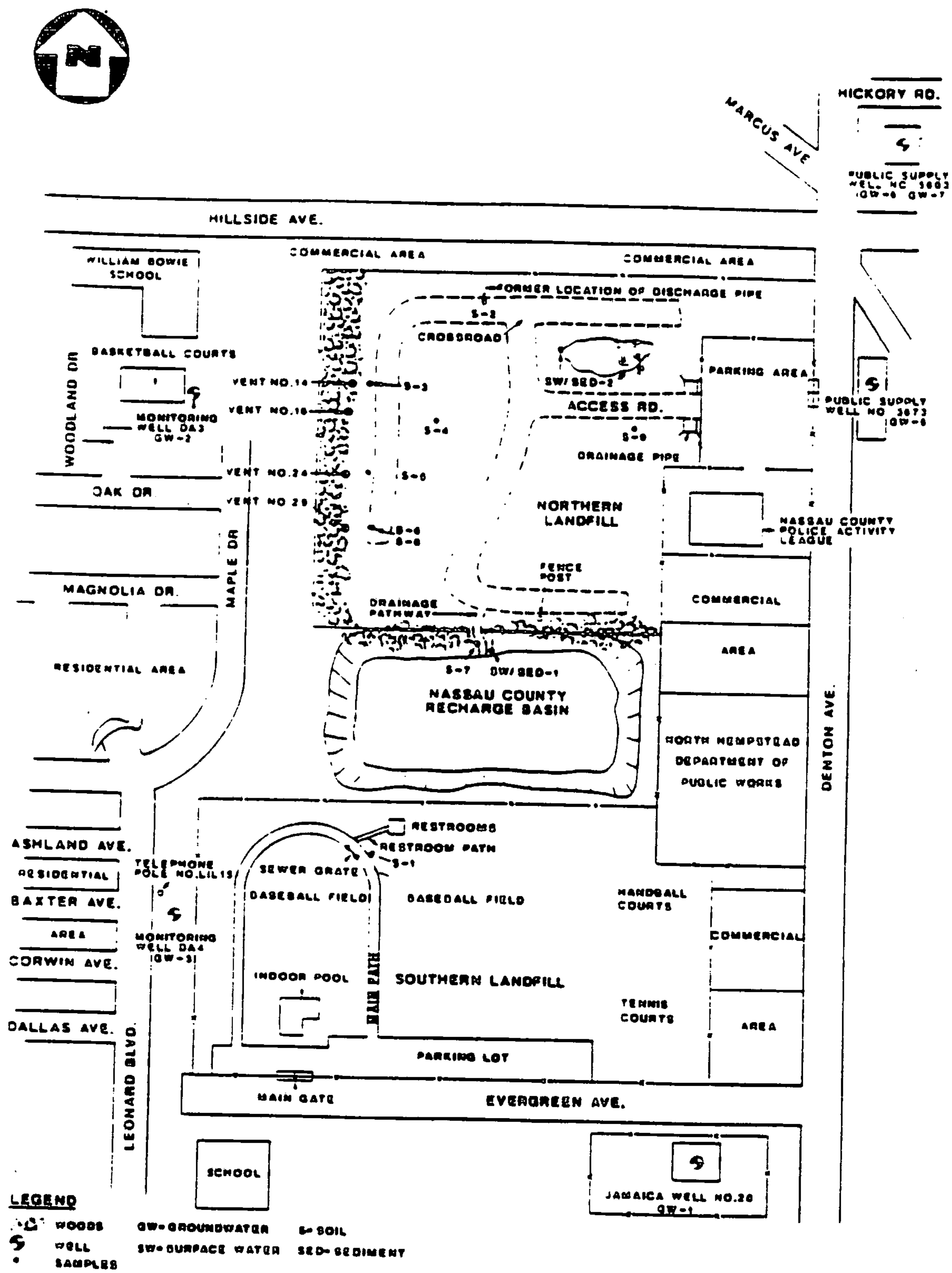
SITE LOCATION MAP
DENTON AVENUE LANDFILL
NEW HYDE PARK, NEW YORK

PREPARED ON BEHALF OF

Town of North Hempstead

ERM ERM–Northeast
Environmental Resources Management

FIGURE
1-1



Source: Figure 2; *Final Draft Site Inspection Report, Denton Avenue Landfill, New Hyde Park, New York*; NUS Corporation; September 20, 1989

NOT TO SCALE

TITLE

NUS SAMPLE LOCATIONS DENTON AVENUE LANDFILL NEW HYDE PARK, NEW YORK

PREPARED ON BEHALF OF

Town of North Hempstead

ERM—Northeast
Environmental Resources Management

FIGURE 2-1

APPENDIX

APPENDIX A
CALCULATION OF ACCEPTABLE CONCENTRATIONS OF INORGANICS IN SOIL BASED ON DIRECT CONTACT EXPOSURE

Chemical	Oral RfD (1) (mg/kg/day)	Weight (kg)	Conversion Factor (1000 ug/mg)	Soil Ingestion Rate (gr/day)	Acceptable Concentration (mg/kg) (2)
Cadmium (3)	0.001	16	1000	0.2	80
Nickel	0.02	16	1000	0.2	1600
Vanadium	0.007	16	1000	0.2	560
Zinc	0.2	16	1000	0.2	16000

(1) Source: HEAST (1992)
(2) Acceptable concentration = RfD * Weight * CF / SIR
(3) Oral RfD for food

Appendix I.A-1

REFERENCE NO. 15

ERM-Northeast

p 1 of 41

Received from:
Nassau Co. Dept. of Health

INVESTIGATION OF LANDFILL IMPACT
ON GROUNDWATER QUALITY

SYOSSET AND NEW HYDE PARK LANDFILLS

Submitted To:

Nassau County Department of Health
Mineola, New York

Prepared By:

ERM-Northeast, Inc.
88 Sunnyside Blvd.
Plainview, New York

January 7, 1983

TABLE OF CONTENTS

p 3/41

TABLE OF CONTENTS (cont'd)

p. 4491

LIST OF TABLES

p5 of 41

LIST OF FIGURES

pg 41

ACKNOWLEDGEMENTS

ERM-Northeast gratefully acknowledges the assistance provided by the Nassau County Department of Health. We particularly appreciate the technical direction, advice and review provided by the following members of the Division of Environmental Health.

Frank Padar, P.E., Deputy Commissioner, Nassau County Department of Health

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Rick Liebe, Public Health Engineer, Nassau County Department of Health

Don Myott, P.E., Chief, Office of Groundwater Management

Stan Juczak P.E., Director, Bureau of Land Resources Management

Jim Adamski, Director, Environmental Health Laboratory

Appreciation is also expressed to James Gildersleeve, Division of Sanitation, Town of Oyster Bay and Bill Cook, Division of Sanitation, Town of North Hempstead for their historical description of landfill operations.

A special acknowledgement is made to Kevin Phillips, P.E., Ph.D. and the staff of Fanning and Phillips for their contribution to this report.

A7A1

SECTION 1.0

INTRODUCTION

1.1 Objectives

ERM-Northeast was retained in October, 1981, by the Nassau County Department of Health to conduct groundwater investigations at two closed municipal landfills in Nassau County. This project was funded by a grant from the New York State Department of Health.

The two sites selected by NCDH to be investigated were the Syosset landfill in the Town of Oyster Bay and the Denton Avenue landfill in New Hyde Park, Town of North Hempstead. Both sites were owned and operated by their respective Towns during the 1950's and 1960's, and subsequently closed. The general purpose of this project was to determine the existence, magnitude and quality of leachate plumes being generated at both sites.

To develop the site-specific objectives for each drilling and sampling program, all available water quality and hydrogeologic data were reviewed. Thick unsaturated zones at each site (100 feet at Syosset, 70 feet at Denton Avenue) and the amount of project resources available for well drilling were important considerations that also determined the scope of the field programs. The objectives for each site are described below:

Syosset Landfill

- Define the local configuration of the water table, the location of the regional groundwater divide with respect to the landfill and the direction and rate of groundwater flow. This was a primary objective at Syosset because the direction of groundwater flow was not precisely known prior to start of drilling.

- Establish groundwater quality beneath the site and determine if leachate is being generated. A previously published report from the 208 Study found minimal leachate impacts.

8 of 41

- Provide permanent monitoring wells that can be used to evaluate long-term groundwater quality trends.

- Determine if industrial waste that was reportedly accepted at Syosset is currently impacting groundwater quality.

- Evaluate the potential for leachate impacts on public water supply wells.

Based on reports indicating that the Syosset landfill was extensively used as an industrial waste disposal site, it was mutually agreed upon by NCDH and ERM-Northeast to commit a larger share of the drilling budget to this site.

Denton Avenue Landfill

- Define the local groundwater gradient in more detail, including water table modifications associated with the large recharge basin, that separates the north and south sections.

- Assess groundwater quality on the downgradient boundary of each landfill site and determine if leachate is currently impacting the upper glacial aquifer.

- Install permanent observation wells that can be used to monitor changes in groundwater quality over time.

- Evaluate the potential for leachate impacts on public water supply wells.

1.2 Report Organization

The Syosset and Denton Avenue landfills are discussed independently. The following organizational format is used for each:

Background - The location and current conditions of each site is described. The operational history and type of wastes disposed of are reviewed. Previous field work, if conducted, is summarized.

Installation of Monitoring Wells - The installation of the monitoring wells is described, the procedures followed in performing the field work are detailed, and the geologic and hydrogeologic setting of each site is discussed.

P9441

Sampling Procedures and Analytical Results - The collection of groundwater samples is discussed and the analytical results presented.

Discussion of Results - The laboratory analyses are discussed and interpreted in conjunction with collected hydrogeologic data.

Conclusions and Recommendations - The major conclusions are summarized and recommendations concerning remedial measures and additional field work are presented.

- NYDOH
Bur. Toxic Sub.

p10441

SECTION 7.0

BACKGROUND

7.1 Site Description

The Denton Avenue landfill consists of two separate 27 acre rectangular plots on the west side of Denton Avenue in New Hyde Park. The landfill plots are bounded on the north by Hillside Avenue, Evergreen Avenue on the south and Leonard Avenue on the west. The two landfill plots are separated by a large recharge basin. The southern section is now the site of a North Hempstead recreational facility. The northern plot is an undeveloped field.

7.2 History of Site

The southern landfill parcel was originally a sandpit owned by the Flatlands Sand and Gravel Company. In 1953, landfill operations were initiated at the site, which was completely excavated at least 45 feet below grade (personal communication, William Cook, 1982). The excavation apparently extended below the water table in some areas because eyewitness reports describe ponded water at the bottom of the sand pit. The entire floor of the site was reportedly covered with refuse before intermediate cover was added and a new lift started. A total of five lifts were required to bring the excavated site to grade. The southern parcel was completed in 1963.

The northern plot is approximately the same size, 27 acres, and was also used for sand and gravel mining. Ponded water on the floor of the pit has been reported indicating that the excavation at least reached the water table. Apparently, some sections of the landfill were started below the water table. This site became operational in 1963. By 1966, it had been filled to capacity and was closed. Following closure, Town personnel report clayey fill material was used to cover approximately 90% of the site. In some areas, the fill was reported to be four feet thick.

Historical information describing the type and quanity of refuse accepted at Denton Avenue is not available. Nassau County Department of Health and Town of North Hempstead officials were unable to identify any reports that quantify waste disposal at the landfill. William Cook, Superintendent of the Town's Sanitation Department, qualitatively described the

A110441

material accepted at both sites as municipal refuse. The only industrial waste accepted by the Town consisted of wood and cardboard. No drums or bulk waste was reported at either site.

To estimate the quantity of leachate generated during the active life of the Denton Avenue landfill sites and following site closure, the same methodology as previously described for the Syosset landfill was used. The assumptions for each site are listed below:

South Site

- Average annual precipitation equals 43.7 inches
- Runoff during operation was assumed to be zero. After closure, annual runoff was calculated to be about 11 inches. This assumes surficial material at the site is Soil Conservation Service hydrologic soil group A (high infiltration capacity). For three winter months the soil is assumed to be group D (low infiltration capacity) because of frozen conditions. Also, 77% of the site was classified as lawn and 23% as impervious surface.
- Irrigation of grass was added to monthly summer rainfall totals (June and September, 1.49 inches; July and August, 1.53 inches)
- Evapotranspiration was calculated to be 27 inches per year after closure and 3 inches per year during site operations.
- Soil moisture retention depth was estimated to be 2 inches.

North Site

- Runoff during operations was assumed to be zero. After closure runoff was estimated to be about 15.5 inches. This was based on soils at the site classed as hydrologic soil group C (shallow and clayey soils) reflecting the partial capping that has taken place. During three winter months, the soils are assigned to group D.
- Evapotranspiration was calculated to be about 24.5 inches after closure and 7 to 8 inches during operation.
- Soil moisture retention depth is 10.0 inches because of higher clay content.

p.120441

Using these values, a recharge rate of 41 inches per year was calculated for both sites during operation. Assuming both sites are about 27 acres, the annual volume of leachate generated at each is approximately 30,087,000 gallons (82,400 gpd).

Monthly recharge calculations for the post-closure period (detailed in Appendix C) show annual recharge rates of about 11 inches at the south site and 7 inches at the north site. The volume of leachate generated at the south site was calculated to be about 8,064,000 gallons per year (22,100 gpd) following site closure. At the north site, approximately 5,132,000 gallons of leachate are generated per year (14,060 gpd).

7.3 Previous Investigations

No studies have been conducted that assess groundwater quality in the vicinity of the Denton Avenue landfill. A line of steel methane vents have been installed along the western boundary of the northern parcel; however, these perforated pipes were placed in the refuse and do not extend to the water table.

p.15 of 41

The Magothy Formation is shown by Kilburn (1979) to be about 325 feet thick beneath the site extending from about -25 to -350 feet below sea level. Well logs show thick units of sandy clay near the top of the Magothy Formation. This was not confirmed during drilling because of limited penetration. Fine grained deposits at the top of the Magothy would tend to reduce hydraulic communication between the Magothy and upper glacial aquifers.

8.3 Hydrogeology

To prepare contour maps of the water table in the vicinity of the Denton Avenue landfill, a synoptic set of water levels were collected from the five landfill monitoring wells and from five nearby observation wells on December 7, 1982. The water level measurements are summarized in Table 8-1.

The configuration of the water table beneath the Denton Avenue landfill sites is shown in Figure 8-2, and the regional water table gradient is shown in Figure 8-3. Water levels collected from well DA-1 were not used to prepare these maps because of inconsistent erratic measurements. Repeated measurements at DA-1 showed the water level to be 1.0 to 1.5 feet too low when compared to DA-2 and DA-3, and the regional gradient established using all nine water levels. This may reflect surveyor error or problems associated with the packing of material around the screen.

Figure 8-2 and 8-3 show that groundwater flow is to the west and west-southwest. The gradient beneath the landfill is approximately 5.28 feet per mile (.001 ft./ft.). Using the McClymonds and Franke (USGS Professional Paper 627-E, 1972), regional estimates of hydraulic conductivity in the glacial aquifer of 2,000 gallons per day per square foot and an estimated porosity of 0.35, the average groundwater velocity in the upper glacial aquifer is calculated to be 0.76 ft./day.

The modification of the regional water table gradient by the large recharge basin that separates the two landfill sites is apparently minimal. Standing water was continually observed in the basin during the 18-month course of this project and the existence of a groundwater mound beneath the basin was anticipated. Water levels in wells DA-2 and DA-4 would have been preferentially higher if mounding occurred. Comparison of these water levels to regional water table trends show no artificial increase. This indicates that infiltration through the floor of the basin is low and that mounding is not currently occurring.

ERM-Northeast

p.A 9

Table 8-1

WATER LEVEL MEASUREMENTS

DENTON AVENUE LANDFILL

WELL UMBER	CASING ELEVATION	November 22, 1982		December 7,	
		DEPTH TO WATER	WATER TABLE ELEVATION	DEPTH TO WATER	WAT EL
DA-1	108.62 -125'	68.25	40.37	69.43	
DA-2	109.92 - 15	68.62	41.30	68.82	
DA-3	121.50 -150	81.10	40.40	81.04	
DA-4	108-97 -95'	68.00	40.97	68.23	
DA-5	109.67 -115' 5	69.03	40.64	69.23	
1124	109.84			66.66	
1683	82.77			50.69	
8694	96.13			54.24	
9982	120.07			86.32	
9983	107.39			75.46	

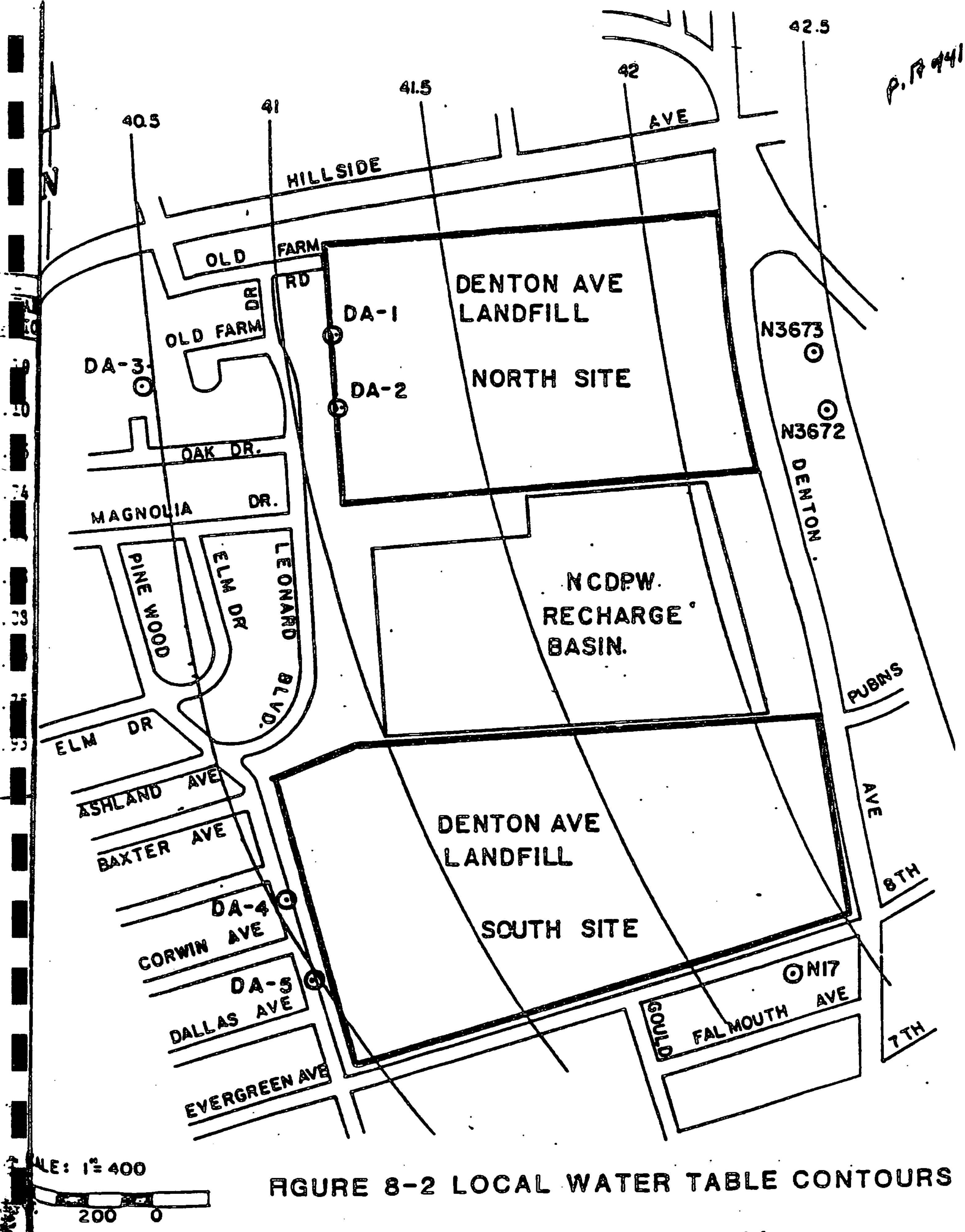
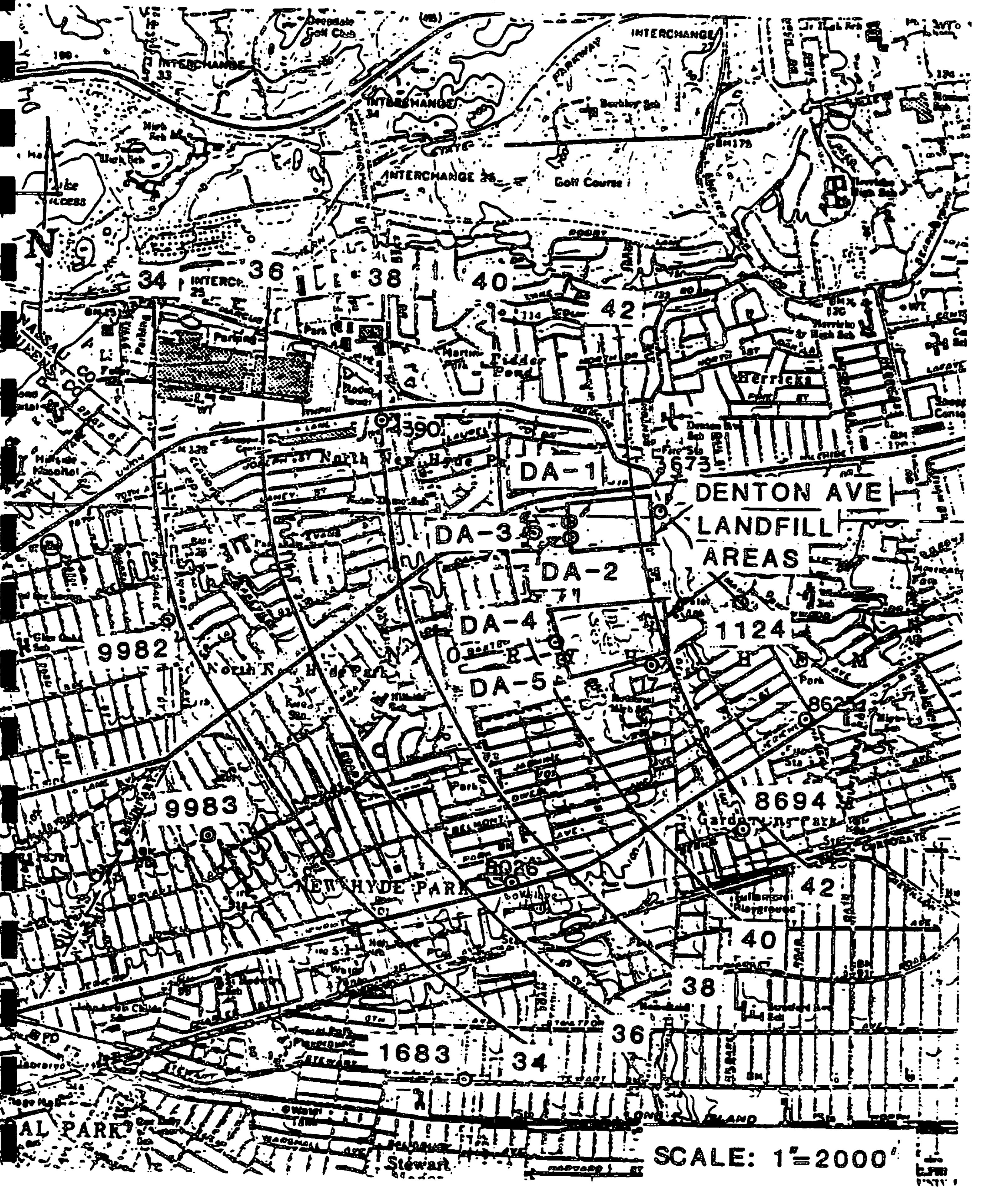


FIGURE 8-2 LOCAL WATER TABLE CONTOURS

DENTON AVE LANDFILL.

GURE 8-3 REGIONAL WATER TABLE MAP-DENTON AVE LANDFIL



p.197/41

Examination of Nassau County groundwater contour maps prepared by the U.S. Geological Survey (Swarzenski, 1963; Kimmel, 1970; Koszalka, 1974) shows the Denton Avenue landfill is located on or just north of the regional groundwater divide. The area adjacent to the divide is generally characterized by vertical flow and recharge to the Magothy aquifer. The wells installed at the Denton Avenue site were not designed to evaluate the Magothy flow system so published data must be relied upon. Maps prepared by Swarzenski (1963) showing the piezometric surface in the Magothy aquifer indicate that lateral flow is in the same direction as the upper glacial aquifer. Heads in the Magothy are several feet lower than in the upper glacial confirming the existence of vertical flow. As previously described at the Syosset landfill, the comparatively low hydraulic conductivity and anistropy of the Magothy aquifer will result in greatly reduced lateral and vertical groundwater flow rates. Based on Swarzenski's maps, the gradient in the Magothy can be assumed to be roughly equal to the upper glacial gradient - .001 ft./ft. Assuming hydraulic conductivity is 400 gpd/sq. ft. (McClymonds and Franke, 1972) and porosity is .30, the average rate of groundwater flow is .18 ft./day. The rate of average vertical flow is estimated to be at least one order of magnitude lower depending on the thickness of local clay units.

p39441

SECTION 9.0

SAMPLING PROCEDURES AND ANALYTICAL RESULTS

9.1 Sampling Program

The same procedure used to sample the Syosset wells was used to sample the Denton Avenue wells. Prior to sampling, each well was sounded and at least one casing volume was removed using a stainless steel bailer. Each well was again assigned a unique bailer to prevent cross-contamination of samples. Samples were collected by Nassau County Department of Health personnel on November 22, 1982, with a second set collected on December 3, 1982. They were analyzed for EPA priority pollutants, an expanded list of heavy metals and general water quality parameters by the NCDH laboratory.

9.2 Analytical Results

The analytical results from both sets of samples are presented in Tables 9-1, 9-2, and 9-3. Acid extractables, base neutrals, pesticides, vinyl chloride, and PCB's were not completed in time to be included in this report.*

* The analytical results for the acid extractables, base neutrals, pesticides, vinyl chloride, and PCB's are provided in Appendix 1.1-11.

ANALYTICAL RESULTS

SECTION 10.0

DISCUSSION OF RESULTS

The monitoring well results do not show the dramatic water quality impacts normally associated with a plume of landfill leachate. To assess the low to moderately elevated anion and cation concentrations, the landfill monitoring wells must be compared to background water quality in the vicinity of Denton Avenue. Table 10-1 presents analytical results from five wells outside the influence of the landfill (Well N8694 is 3,000 feet south of the landfill; N8623 is 3,000 feet southeast of the site; N8026 is south-southwest; N4390 is 3,500 feet northwest and N3673 is 300 feet east; well locations are shown in Figure 8-3). The parameter concentrations in the five background wells show relatively little variation and provide a consistent basis for evaluating the monitoring well results.

The results from DA-1 clearly show some leachate impacts. The concentrations of ammonia, 11.0 mg/l and iron, 61 mg/l are very high and these constituents are traditionally good leachate indicators. Other anion and cation concentrations, however, are only moderately elevated. The conductivity, 466 umhos, is higher than the average background level, about 300 umhos, but much lower than the 2000 umhos found in the downgradient wells at the Syosset landfill. Similarly, the total alkalinity, total hardness, chloride and sodium concentrations are higher than background levels but they are not sharply elevated as might have been expected.

Interpreting the results from the other four landfill wells is more difficult. The conductivity in the landfill wells is equal to or even lower than background. Total hardness and total alkalinity concentrations are marginally greater in the landfill wells than the background wells. There is no significant difference between the sodium and chloride concentrations and the background sulfate and nitrate levels are higher than in the landfill wells. The only parameters that differ markedly from background levels are iron and manganese. The iron concentrations, which range from 21 mg/l to 75 mg/l and the manganese concentrations of 0.17 mg/l to 1.93 mg/l are commensurate with highly concentrated landfill leachate. Background iron concentrations in the area range from less than 0.5 mg/l to 2.9 mg/l.

p25 9/4

Table 10-1

BACKGROUND WATER QUALITY

DENTON AVENUE LANDFILL

PARAMETER	WELL NUMBER				
	8026	8694	8623	4390	36
Well Depth	-6	+16	+14	-141	-28
Screened Aquifer	Glacial	Glacial	Glacial	Upp.Mag.	Upp.
Total Alkalinity	26	7	11	35	16
Hardness	74	73	71	94	74
Spec. Conductance	317	338	248	250	290
pH	6.2	6.0	6.2	6.4	6.1
Ammonia	.45	.07	<.01	<.01	<.0
Nitrate	5.47	4.6	6.65	4.6	10..
Chlorides	27.8	41.4	12	28	19.
Sulphate	40	85	31	32	46
Sodium	17	31.0	<3	14.0	14
Iron	2.9	<.5	.19	<.5	.26
Date of Analysis	6/81	8/82	1/81	1/80	5/7

p26

11.2 Recommendations

1. The wells installed during this study should be sampled regularly for at least a year to evaluate average annual and maximum plume concentrations. The review of data collected over the course of a year will permit a comprehensive assessment of leachate strength.

2. Because the landfill is located close to the groundwater divide where vertical components of flow are important, the head relationship between the upper glaical and Magothy aquifers should be quantified. This would require the installation of two or three additional wells at each landfill site. Water samples obtained from these wells would also establish vertical concentration gradients.

3. Major remedial measures do not seem to be warranted at either site because of the low strength of the leachate being produced, the absence of public water supply impacts and the partial capping that has already taken place. Minor remedial actions that would further reduce leachate generation are desirable.

   At the north site, the extent of the clayey fill should be determined by conducting a series of shallow soil borings. The permeability of this material should be measured. Fill with a low permeability should be added to those portions of the site not covered by the original clayey fill. Finally, the entire site should be regraded to facilitate positive drainage toward the periphery and eliminate the small depressions that currently collect and store runoff.

   At the south site, regrading or additional paving would decrease infiltration and leachate production, although modification to the ball fields and other outdoor recreation areas is not considered necessary.

R29141

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9. Thornthwaite, C. W. and Mather, J. R., 1957; Instructions and Tables for Computing Potential Evapotranspiration and the Water Balance; Publication in Climatology, Drexel Institute.

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APPENDIX A

WELL LOGS

Environmental Resources Management

A 3/6/91

Drilling Log

Project: NYSDOH Landfill Inv. Owner: NCDH

Location: Denton Ave. L.F. North Site W.O. Number:

Well Number: DA-1 Total Depth: 120 ft. Diameter: 8 in.

Surface Elevation: 108.62 Water Level: Initial DTW 70.10' 24-hrs. 39.19

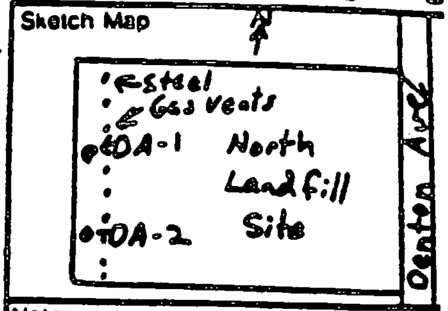
Screen: Dia. 2 in. Length: 10 ft. Slot Size: .02

Casing: Dia. 2 in. Length: 110 ft. Type: steel

Drilling Company: Layne-NY Drilling Method: holl. stem auger

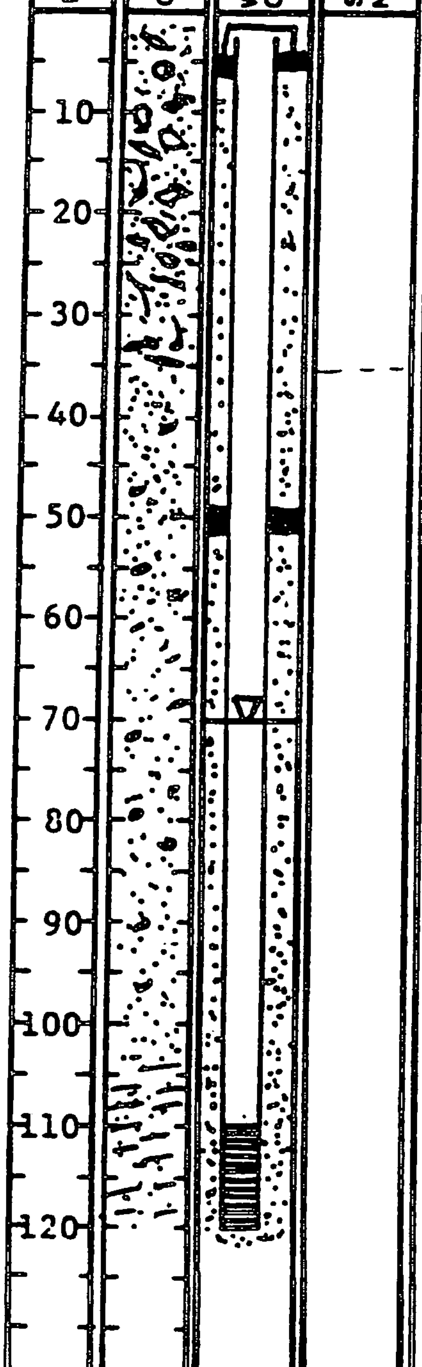
Driller: Log By: Date Drilled:

Sketch Map



Notes: Bentonite seal (20 lbs.) at about 50'

Depth (Feet)	Graphic Log	Well Construction	Sample Number	Description/Soil Classification (Color, Texture, Structures)



Dark grayish brown medium to fine sand with soft, mixed household refuse.

Discolored black coarse to fine sand with refuse, strong odor, constant to 35'.

Discolored brownish gray medium to fine sand with some gravel - odorous and warm.

Same as above.

Discolored, odorous, brownish-gray medium to coarse sand with gravel and some small cobbles.

* Materials change indicated by driller.

Light brownish gray fine sand with medium sand and mica interstitial silt and clay - odor less than above.

Environmental Resources Management

Drilling Log

Project: NYSDOH Landfill Inv. Owner: NCDH

Location: Denton Ave. L.F. W.O. Number:

Well Number: DA-2 Total Depth: 95 ft. Diameter: 8 in.

Surface Elevation: 109.92 Water Level: Initial DTW 70.2' 24-hrs. 41.10

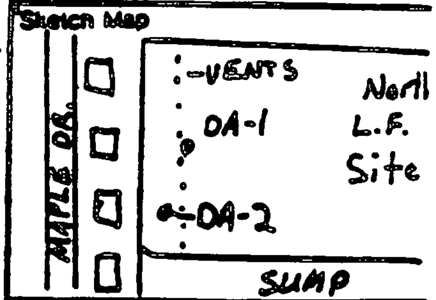
Screen: Dia. 2 in. Length 10 ft. Slot Size .02

Casing: Dia. 2 in. Length 85 ft. Type steel

Drilling Company: Layne-NY Drilling Method: holl. stem auger

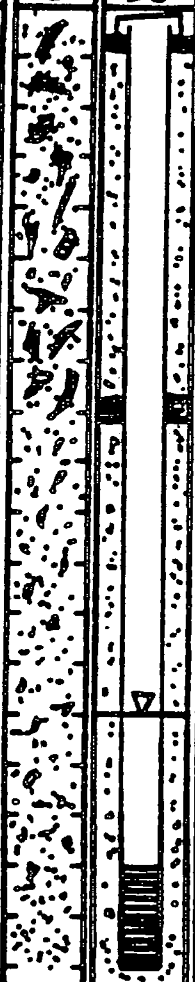
Driller: Bill Sanford Log By: C. Werle Date Drilled: 11/11/82

Sketch Map



Notes: Bentonite seal (20 lbs) at about 40'

Depth (Feet)	Graphic Log	Well Construction	Sample Number	Description/Soil Classification (Color, Texture, Structures)
				Dark grayish black fine to coarse sand and gravel with refuse, to 40 ft.
10				
20				Same as above.
30				
40				Discolored brownish gray medium to coarse sand and gravel, some fine sand, strong odor.
50				
60				
70				Brownish gray medium to coarse sand and gravel, strong odor.
80				
90				Grayish black medium to fine sand with some coarse sand.
100				



#530471

Environmental Resources Management

Drilling Log

Project NYSDOH Landfill Inv. Owner NCDH

Location Wm. Bowie School W.O. Number

Well Number DA-3 Total Depth 100 ft. Diameter 8 in.

Surface Elevation 121.50 Water Level: Initial DTW 81.39 24-hrs. 40.46

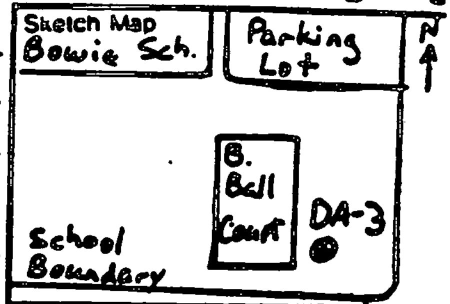
Screen: Dia. 2 in. Length 10 ft. Slot Size .02

Casing: Dia. 1 in. Length 90 ft. Type steel

Drilling Company Layne-NY Drilling Method holl.stem auger

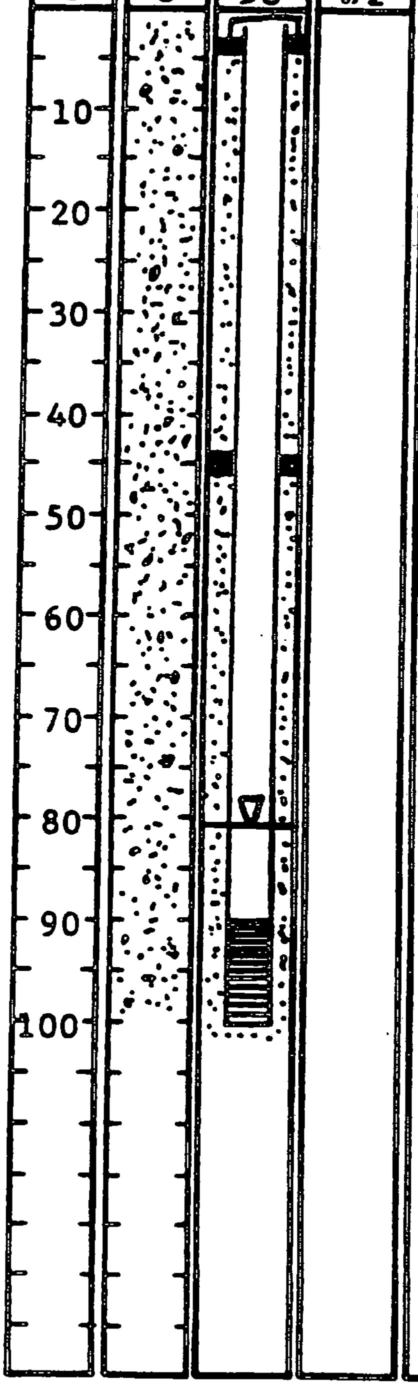
Driller Bill Sanford Log By C. Werle Date Drilled 11/11/82

Sketch Map



Notes Bentonite seal (20 lbs.) at about 45'

Depth (Feet)	Graphic Log	Well Construction	Sample Number	Description/Soil Classification (Color, Texture, Structures)



Orange brown fine to medium sand with coarse sand and gravel.

Tan brown medium to coarse sand and gravel, some fine sand.

Same as above.

Same as above.

Same as above.

Environmental Resources Management

ß31d/91 **Drilling Lo**

Project NYSDOH Landfill Inv. Owner NCDH

Location Denton Ave. L.F. South Site W.O. Number

Well Number DA-4 Total Depth 95 ft. Diameter 8 in.

Surface Elevation 108.97 Water Level: Initial DTW 68.26' 24-hrs. 40.74

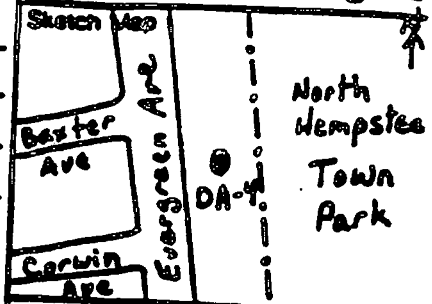
Screen: Dia. 2 in. Length 10 ft. Slot Size .02

Casing: Dia. 2 in. Length 85 ft. Type steel

Drilling Company Layne-NY Drilling Method holl. stem auger

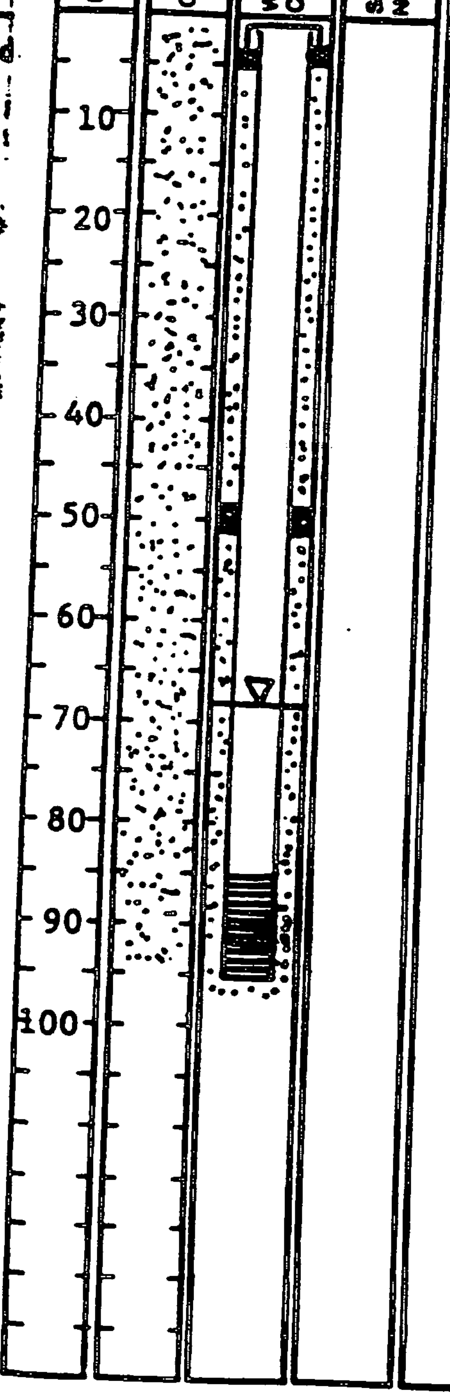
Driller Bill Sanford Log By C. Werle Date Drilled 11/12/82

Sketch Map



Notes Bentonite seal (20 lbs.) at about 50'

Depth (Feet)	Graphic Log	Well Construction	Sample Number	Description/Soil Classification (Color, Texture, Structures)



Tan brown medium to coarse quartz sand and gravel, some fine sand, subangular to subround.

Same as above.

Same as above.

Same as above.

A35 441

Environmental Resources Management

Drilling L

Project: NYSDOH Landfill Inv. Owner: NCDH

Location: Denton Ave. L.F. South Site W.O. Number:

Well Number: DA-5 Total Depth: 114 ft. Diameter: 8 in.

Surface Elevation: 109.67 Water Level: Initial DTW 69.67 24-hrs. 40.44

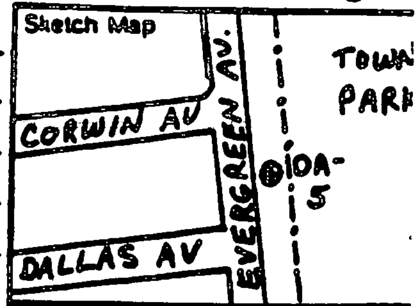
Screen: Dia. 2 in. Length: 10 ft. Slot Size: .02

Casing: Dia. 2 in. Length: 104 ft. Type: steel

Drilling Company: Layne-NY Drilling Method: holl.stem auger

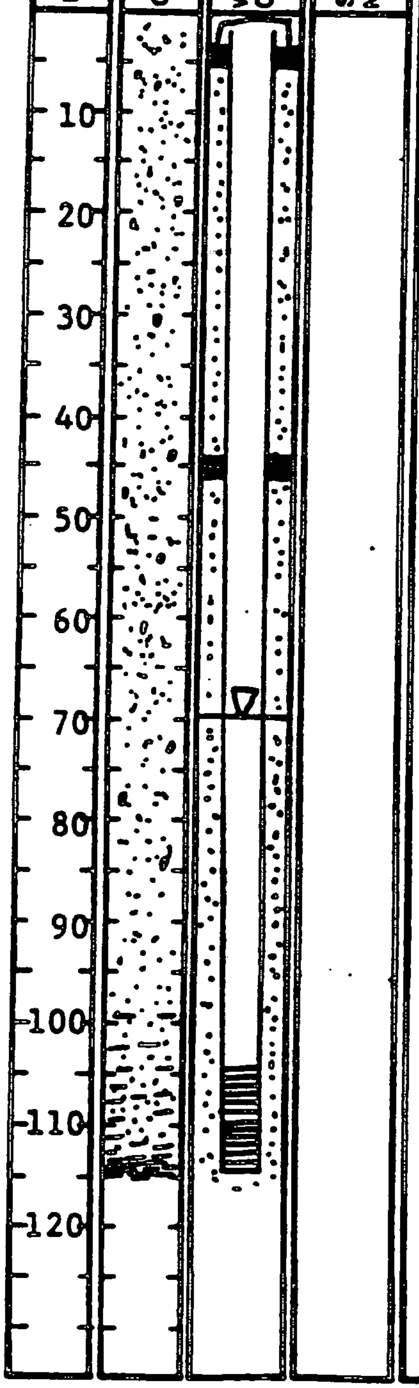
Driller: Bill Sanford Log By: C. Werle Date Drilled: 11/12/82

Sketch Map



Notes: Bentonite seal (20 lbs.) at about

Depth (Feet)	Graphic Log	Well Construction	Sample Number	Description/Soil Classification (Color, Texture, Structures)



Tan-brown medium to coarse quartz sand with fine to coarse gravel, some fine sand, sub-angular to subround.

Same as above.

Same as above.

Driller indicates materials change yellow-tan fir to medium sand with mica and interstitial clay.

One foot seam of light tan-brown silty micaceous clay - cohesive, plastic, dense, laminated.

APPENDIX C

WATER BALANCE CALCULATIONS

DENTON AVENUE LANDFILL

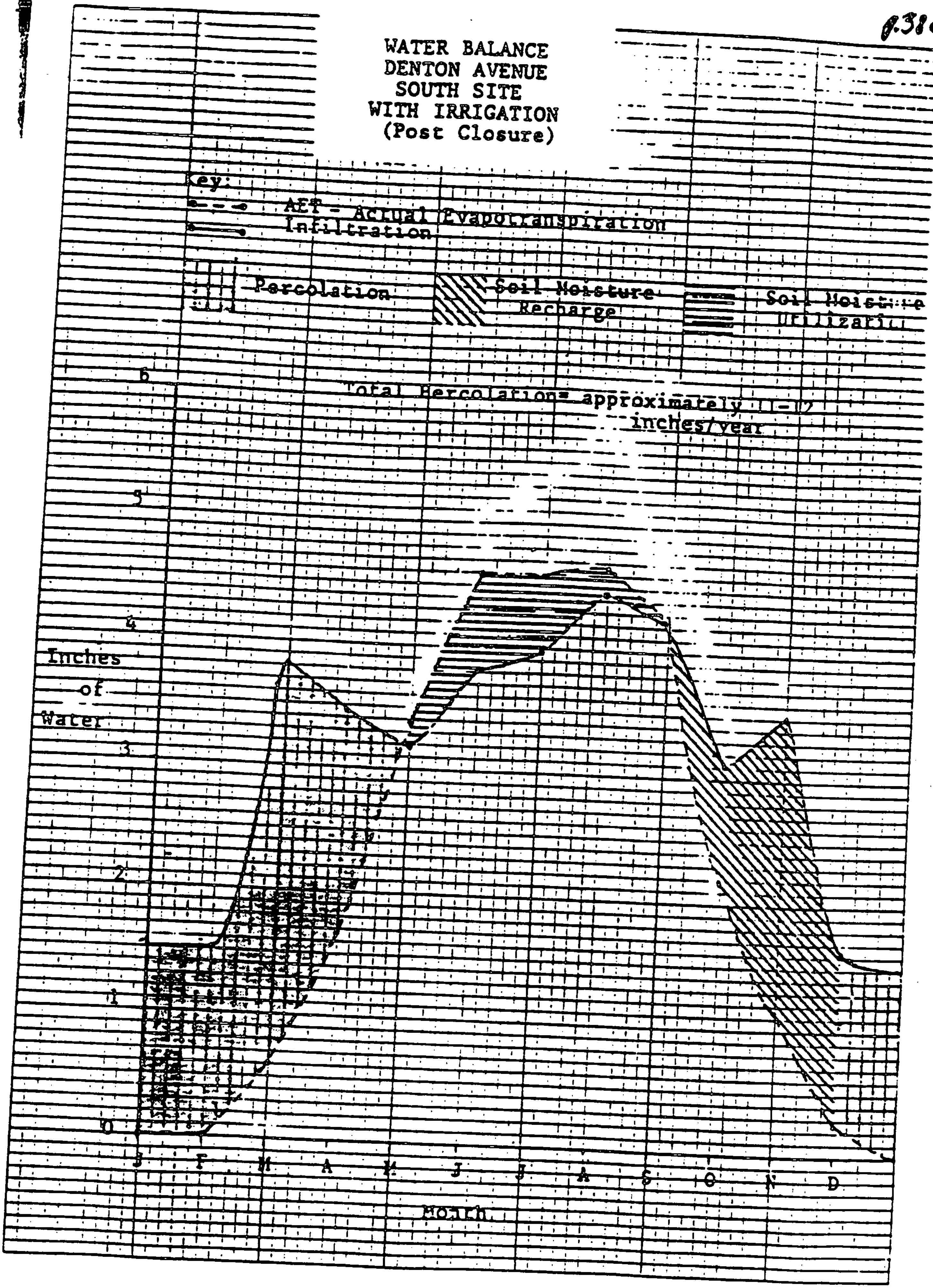
WATER BALANCE
DENTON AVENUE
SOUTH SITE
(Post Closure)

Months of the year

e Table 1A	J	F	M	A	M	J	J	A	S	O	N	D	ANNUAL
PET djusted)	0	0	0.62	1.67	3.36	4.84	5.63	5.72	4.25	2.18	1.15	0.25	29.67
P (2)	3.31	3.37	4.44	4.01	3.46	4.42	4.70	5.59	5.12	3.38	3.97	3.92	49.69
R/O (3)	1.78	1.83	0.61	0.45	0.27	0.60	0.72	1.14	0.91	0.24	0.43	2.30	11.28
I (P-R/O)	1.53	1.54	3.83	3.56	3.19	3.82	3.98	4.45	4.21	3.14	3.54	1.62	38.41
-PET	1.53	1.54	3.21	1.89	-0.17	-1.02	-1.65	-1.27	-0.04	0.96	2.39	1.37	–
Neg. -PET					-0.17	-1.19	-2.84	-4.11	-4.15				–
ST	2	2	2	2	1.83	1.05	0.44	0.23	0.22	1.18	2	2	16.95
ST	0	0	0	0	-0.17	-0.78	-0.61	-0.21	-0.01	+0.96	+0.82	0	0
AET	0	0	0.62	1.67	3.36	4.60	4.59	4.66	4.22	2.18	1.15	0.25	27.05
Perc (4)	1.53	1.54	3.21	1.89	0	0	0	0	0	0	1.57	1.37	11.11

(1) See Table 1A for explanation
(2) Sum of P and irrigation for months of June, July, August and September
(3) Runoff calculated by Soil Conservation Service Method
(4) Perc= (P-R/O) – ΔST – AET

p.38 of 91

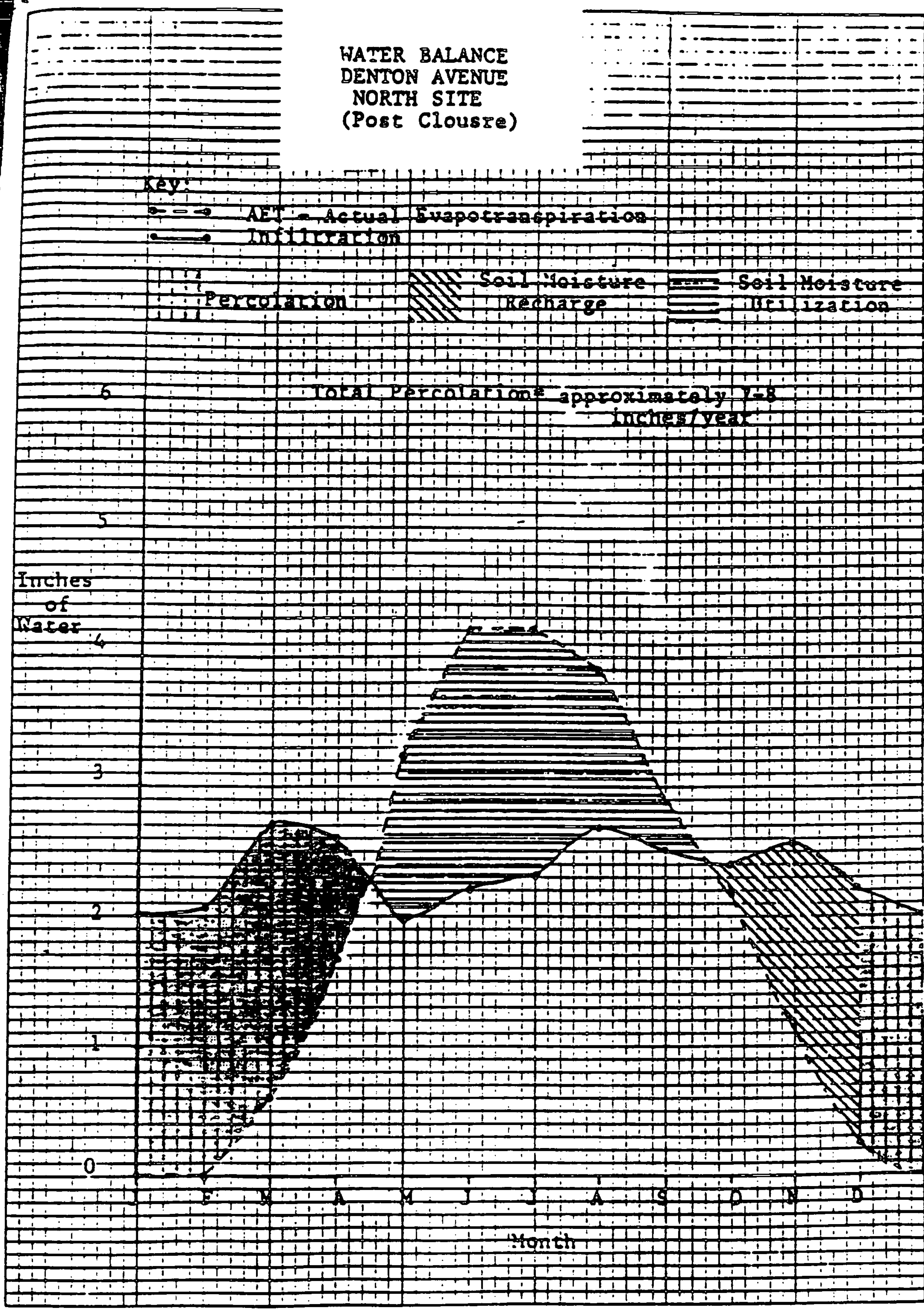

WATER BALANCE
DENTON AVENUE
SOUTH SITE
WITH IRRIGATION
(Post Closure)
Key:
AET - Actual Evapotranspiration
Infiltration
Percolation
Soil Moisture
Recharge
Soil Moist
Utilizati
Total Percolation= approximately 11-17
inches/year
6
5
4
3
2
1
0
Inches
of
Water
J
F
M
A
M
J
J
A
S
O
N
D
Month

WATER BALANCE
DENTON AVENUE
NORTH SITE
(Post Closure)

Months of the year

	J	F	M	A	M	J	J	A	S	O	N	D	ANNUAL
PET justed)	0	0	0.62	1.67	3.36	4.84	5.63	5.72	4.25	2.18	1.15	0.25	29.67
›	3.31	3.37	4.44	4.01	3.46	2.93	3.17	4.06	3.63	3.38	3.97	3.92	43.65
R/O (1)	1.30	1.30	1.70	1.40	1.50	0.72	0.85	1.40	1.10	0.98	1.40	1.70	15.35
I -R/O)	2.01	2.07	2.74	2.61	1.96	2.21	2.32	2.66	2.53	2.40	2.57	2.22	28.30
ET	2.01	2.07	2.12	0.94	-1.40	-2.63	-3.31	-3.06	-1.72	0.22	1.42	1.97	-
eg. ET					-1.40	-4.03	-7.34	-10.40	-12.12				-
T	10	10	10	10	8.72	6.72	4.81	3.55	2.99	3.21	4.63	6.60	81.23
T	0	0	0	0	-1.28	-2.00	-1.91	-1.26	-0.56	+0.22	+1.42	+1.97	-3.40
T	0	0	0.62	1.67	3.24	4.21	4.23	3.92	3.09	2.18	1.15	0.25	24.56
(2) c	2.01	2.07	2.12	0.94	0	0	0	0	0	0	0	0	7.14

(1) Runoff calculated by Soil Conservation Service Method
(2) Perc= (P-R/O) $-\Delta$ ST - AET


WATER BALANCE
DENTON AVENUE
NORTH SITE
(Post Clousre)
Key:
AET = Actual Evapotranspiration
Infiltration
Percolation
Soil Moisture Recharge
Soil Moisture Utilization
Total Percolation= approximately 7-8 inches/year
Inches of Water
6
5
4
3
2
1
0
F
M
A
M
J
J
A
S
O
N
D
Month

pd 1/9/91

Table 1A
Explanation of abbreviations used
in water balance

PET -- Potential Evapotranspiration
P -- Precipitation
R/O -- Runoff
I -- Infiltration = Precipitation - Runoff
ST -- Soil Moisture Storage
AET -- Actual Evapotranspiration
Perc -- Percolation (leachate)

REPORT
SPECIAL SITUATION

Nassau County
Department of Health

Appendix 1.1

REFERENCE NO. 16

Route To	Init.		
V. Padar			
Dr. Dowling			
		Received from:	
		Nassau Co. Dept. of Health	

☒ Initial Report

☐ Update

1 2 3

☒ IMPORTANT

☐ ROUTINE

TNH-Denton

Subject

Denton Ave. Landfill

Program	Public Water Supply
Prepared By	Michael J. Alarcon
Date	November 12, 1982

Item: Describe event; significance; action taken and planned; and recommended action by others.

Well drilling at the Denton Ave. Landfill in New Hyde Park began yesterday as part of the State funded investigation which also includes the Syosset Landfill. Two wells will be approximately 75' deep, two will be approximately 120' deep and one off-site well will be approximately 100' deep. All wells will be 2" diam. with steel casing and 10' stainless steel well screens.

The first well installed yesterday near the northwest corner of the landfill (Well #DA-1) was installed through discolored medium-coarse sand which may have been darkened as a result of leachate passage. A distinct putrescent type odor was evident during the drilling.

Well drilling will continue today and if necessary tomorrow morning. Wells will be developed next week and sampled late next week or early the following week. Drilling is being performed by Layne New York and our project consultant in ERM-Northeast.

The Town of North Hempstead resolution and approval to commence drilling was issued on November 9.

MJA:da

cc: Sheldon O. Smith
Gerard E. Donohue
S. Juczak, R.Curiano
R. Close
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R. Liebe

Attachments:

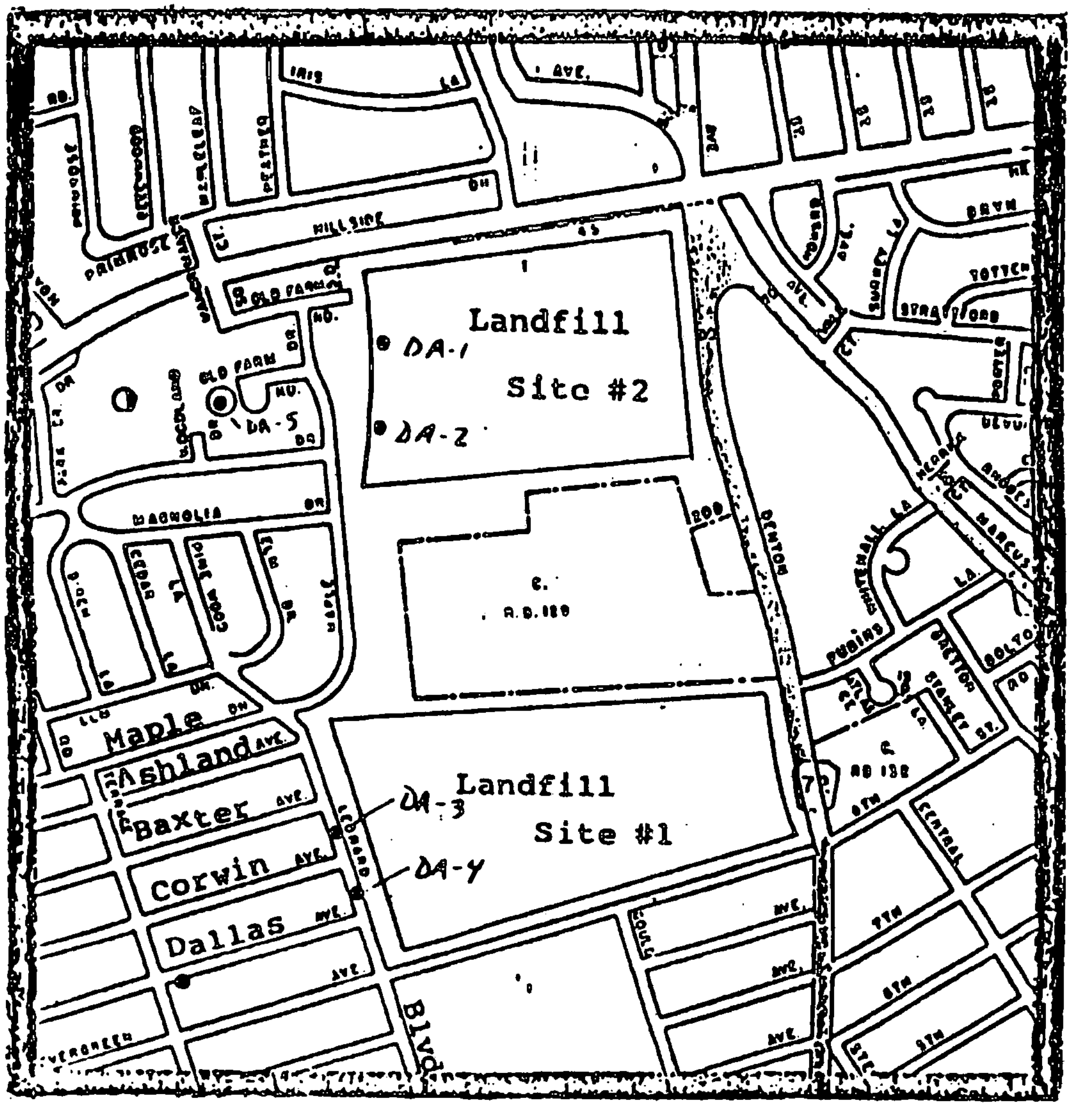
☐ Copy sent to Public Information.

HD 267 2/74

Vicinity Sketch

New Hyde Park Municipal Landfill

Sites #1 and #2



-N-

\- Not to scale -

O - Manor Oaks - Wm. R. Bowie School

● - Proposed monitoring well location

◎ - Alternate proposed monitoring well location (Town approval not required)

p. 2 of 2

Received from:
Nassau Co. Dept. of Health

EPA Priority Pollutant I Organic

Analytical Results*

for

Landfill Investigation Study

GROUNDWATER MONITORING

~~Syosset Landfill~~ - 3 pages

New Hyde Park (Denton Avenue) Landfill - 3 pages

* Analyzed by Nassau County Department of Health Laboratory

REFERENCE NO. 17

Appendix 1.1-11

G 144

Analytical Results - EPA Priority Pollutant I Organics
Donton Avenue Landfill
(All results in ug/l)

Parameter	Detection Limit(ug/l)	Well Number #1 11/82	#2 11/82	#3 11/82	#4 11/82	#5 11/82
Polycyclic Aromatic Hydrocarbons						
Nitrobenzene	1	-	-	-	-	-
Naphthalene	1	-	-	-	-	-
Methylnaphthalene						
Dimethylnaphthalene	1	NR	-	NR	76	-
2-Chloronaphthalene - - - -						
Fluorene - - - - - - - - - - - - - -	1	NR	-	NR	NR	-
Acenaphthene - - - - - - - -						
Acenaphthylene	1	NR	-	NR	NR	-
Phenanthrene	1	NR	-	NR	-	-
Anthracene	1	NR	-	NR	-	-
Fluoranthene	1	-	-	-	-	-
Pyrene	1	-	-	-	-	-
Chrysene & benzo (a) anthracene	1	-	-	-	-	-
Benzo (b) fluoranthene	1	-	-	-	-	-
Benzo (k) fluoranthene	1	-	-	-	-	-
Benzo (a) pyrene	1	-	-	-	-	-
Dibenzo (a,h) anthracene	1	-	-	-	-	-
Benzo (a,h,i) perylene	1	-	-	-	-	-
Indeno (1,2,3-c,d) pyrene	1	-	-	-	-	-
Benzidines						
3,3' - dichlorobenzidine	1	-	-	-	-	-
Benzidine						
Phenols						
Phenol	1	-	-	-	-	-
4-Nitrophenol	1	-	-	-	-	-
2,4-Dinitrophenol	1	-	-	-	-	-
2-Chlorophenol	5	-	-	-	-	-
2-Nitrophenol	1	-	-	-	-	-
2,4-Dimethylphenol	5	-	-	-	-	-
p-Chloro-m-cresol	1	-	-	-	3	-
4,6-Dinitro-o-cresol	1	-	-	-	-	-
2,4-Dichlorophenol	1	-	-	-	-	-
2,4,6-Trichlorophenol	5	-	-	-	-	-
Thymol						
Pentachlorophenol	1	-	-	-	-	-

p 2 of 4

[redacted]yti[redacted] Ro[redacted]s [redacted]A P[redacted]rity [redacted]llutant I Organics Page 2

Denton Avenue Landfill
(All results in ug/l)

Parameter	Detection Limit (ug/l)	Well Number #1 11/82	#2 11/82	#3 11/82	#4 11/82	#5 11/82
olychlorinated Biphenyls						
CB - 1016	1	-	-	-	-	-
CB - 1221	1	-	-	-	-	-
'CB - 1232	1	-	-	-	-	-
'CB - 1242	1	-	-	-	-	-
'CB - 1248	1	-	-	-	-	-
:B - 1254	1	-	-	-	-	-
'CB - 1260	1	-	-	-	-	-
hlorinated Hydrocarbons						
,2,4 - Trichlorobenzene	1	-	-	-	-	-
lexachlorobutadiene	1	-	-	-	-	-
exachloroethane	1	-	-	-	-	-
lexachlorocyclopentadiene	1	-	-	-	-	-
,6-Dinitrotoluene	1	-	-	-	-	-
,4-Dinitrotoluene	1	-	-	-	-	-
hthalates						
imethyl phthalate	2	-	-	-	-	-
iethyl phthalate	2	10	5	8	-	-
i-n-butyl phthalate	2	-	2	22	-	-
utylbenzyl phthalate	1	1	-	6	-	-
s (2-ethylhexyl) phthalate	1	10	-	19	-	-
i-n-octyl phthalate	1	-	-	11	-	-
itrosamines						
-nitrosodimethylamine						
-nitrosodi-n-propylamine	1					
-nitrosodiphenylamine	1					
laloethers and Isophorone						
is - (2-chloroisopropyl) ether	5	-	-	-	-	-
is - (2-chloroethyl) ether	5	-	-	-	-	-
sophorone						
is - (2-chloroethoxy) methane	5	-	-	-	-	-
-Chlorophenyl phenyl ether	5	-	-	-	6	6
-Bromophenyl phenyl ether	1	-	4	-	-	-

Analytical Results - EPA Priority Pollutant (Organics Page -
Donton Avenue Landfill
(All results in ug/l)

Parameter	Detection Limit (ug/l)	Well Number #1 11/82	#2 11/82	#3 11/82	#4 11/82	#5 11/82
lalogenated Pesticides						
lexachlorobenzene	1	-	-	-	-	-
a-BHC	1	-	-	-	-	-
g-BHC	1	-	-	-	-	-
b-BHC	1	-	-	-	-	-
leptachlor	1	-	-	-	-	-
d-BHC	1	-	-	-	-	-
Aldrin	1	-	-	-	-	-
Heptachlor epoxide	1	-	-	-	-	-
a-Endosulfan	1	-	-	-	-	-
4,4' - DDE	1	-	-	-	-	-
Dieldrin	1	-	-	-	-	-
Endrin	1	-	-	-	-	-
4,4' - DDD	1	-	-	-	-	-
b-Endosulfan	1	-	-	-	-	-
4,4' - DDT	1	-	-	-	-	-
Endrin aldehyde	1	-	-	-	-	-
Endosulfan sulfate	1	-	-	-	-	-
Chlordane	1	-	-	-	-	-
Toxaphene	3	-	-	-	-	-
Volatile Halogenated Gases		1/83	1/83	1/83	1/83	1/83
Vinyl Chloride	10	-	-	-	-	-

Abbreviations: - = below detection limit
NR = not reported

p. 4 of 4

REFERENCE NO. 18

Hydrogeology of Northwestern Nassau and Northeastern Queens Counties Long Island, New York

By WOLFGANG V. SWARZENSKI

GEOLOGICAL SURVEY WATER-SUPPLY PAPER 1657

Prepared in cooperation with the Nassau County Department of Public Works and the New York State Water Resources Commission

With special reference to water in Cretaceous and Pleistocene aquifers

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UNITED STATES DEPARTMENT OF THE INTERIOR

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Thomas B. Nolan, *Director*

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(Continued on next card)

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CONTENTS

ILLUSTRATIONS

[Plates are in separate volume]

TABLES

ment of Public Works, and Arthur H. Johnson, Associate Hydraulic Engineer, New York State Water Resources Commission (formerly New York State Water Power and Control Commission), for their generous and continued support of the investigation. The present report includes data collected by U.S. Geological Survey personnel and cooperating agencies during the course of many years. Published and unpublished information was used freely in an effort to solve the complex geologic and hydrologic problems of the report area. The work of earlier investigators is acknowledged.

WELL-NUMBERING SYSTEM AND MAP COORDINATES

Well numbers on Long Island are assigned in sequence by the New York State Water Resources Commission as information is obtained and have no bearing on location. The well numbers are preceded by a letter designating the county in which the well is located; thus, Q1293 refers to a well in Queens County, whereas N1293 is in Nassau County. As an aid in locating wells, the map area (well-location map, pl. 1) has been subdivided into 2½-minute rectangles, which are designated by number and letter in the indexed margins. The coordinates, given in all major tables of the report, designate the rectangle in which the well is located and indicate distances of the well in miles, first north, then west, from the southeast corner of that rectangle. Geologic and hydrologic data for wells shown on plate 1, but not published in this report, are available for consultation in the files of the Geological Survey office at Mineola, N.Y.

GEOGRAPHY

TOPOGRAPHY AND DRAINAGE

Long Island lies entirely within the Coastal Plain province of the northeastern United States. The area of investigation, on western Long Island, may be subdivided into three morphologic units; from north to south (1) the headlands, including Great Neck and Manhasset Neck, (2) the Harbor Hill terminal moraine, and (3) the glacial-outwash plain. (See pl. 8.) The headlands rise abruptly from Long Island Sound and its bays to rather uniform altitudes of 80 to 100 feet near their northern tips. Southward, the headlands, which are mantled thinly by glacial till, become increasingly irregular, being dissected by small streams discharging into the bays, to the east and west. Individual hills rise to altitudes above 200 feet. Within the project area, the headlands are indented by three major bays, Hempstead Harbor, Manhasset Bay, and Little Neck Bay. These bays have a general north-south orientation and are 3 to 5 miles in length. The Harbor Hill terminal moraine, consisting of a series of coalescing irregular hills, forms a pronounced ridge, trending to the northeast, that rises 80 to 150 feet above the headlands. The highest altitudes in western Long Island are along this ridge, Harbor Hill itself rising to 368 feet above sea level. The glacial outwash plain of sand and gravel abuts the moraine and slopes southward from an altitude of about 140 feet at the southern edge of the moraine to about 80 feet in Garden City; thence, its gentle southward slope is continued to the shore areas of southern Nassau County at gradients of about 20 feet per mile.

There are no large streams in the area. Small streams, sustained by local ground-water discharge, flow predominantly to the north and west at average rates of 0.25 to 3.0 cfs (cubic feet per second). An exception is Cedar Swamp Creek, which flows into Hempstead Harbor near Glen Cove at average discharge rates of more than 7 cfs. Most of its drainage area, however, lies beyond the eastern limit of the area. Nearly all streams are small in relation to the valleys they occupy. The oversized valleys originated in Pleistocene time, when continental ice masses and associated melt water modified the pattern of streamflow into the Atlantic Ocean and the depression of Long Island Sound.

CLIMATE

The climate of Long Island, in contrast to other localities within the State of New York, is tempered by its low altitudes and proximity to the ocean. Precipitation is distributed fairly evenly throughout the year, amounting to an annual average of 44.20 inches for 1938–39 to 1957–58 at Mineola, in Nassau County. At that station, a low of 32.60 inches was reported for 1946–47, whereas in 1957–58 a high of 57.64 inches was recorded. Local variations in precipitation are shown in figure 2, in which annual precipitation at two stations in Nassau County (Manhasset and Mineola, N.Y.) is compared with records for New York City, for the period 1938–39 to 1957–58. Annual precipitation rates shown in the diagram are computed for the water year, October 1 to September 30.

Figure 3 shows monthly average precipitation and temperatures at The Battery, New York City, N.Y., based on long term records by the U.S. Weather Bureau. Precipitation reaches a maximum during August at The Battery and also in Nassau County. Monthly average precipitation ranges from 3 to more than 4½ inches at most stations in Nassau County.

The annual average temperature in New York City is 52.7°F (1872–1957, U.S. Weather Bureau). Average temperatures for January and July are 31.8°F and 74.6°F, respectively. (See fig. 3.) In New York City and on Long Island temperatures are rarely below 0° or higher than 95°F. The frost-free season has an average length of about 190 days, the average date of the last and first killing frost being the establishment of many new industries in the area. Diversified light manufacturing, often of a highly specialized type, is concentrated in the central part of Nassau County; some industries are located along the north shore which, however, is still predominantly an area of residential development and country estates. Truck farming, formerly of some economic importance, had all but disappeared from northwestern Nassau County in 1959.

GEOLOGY

SUMMARY OF STRATIGRAPHY

On Long Island and in the project area, unconsolidated sediments of Quaternary and Cretaceous age rest on a crystalline bedrock surface that slopes to the southeast. These units are shown diagrammatically in figure 4. The bedrock probably is of Precambrian age. The Late Cretaceous deposits, mostly of terrestrial origin, are the Raritan and Magothy(?) formations. Pleistocene deposits of pre-Wisconsin age are the Jameco gravel and Gardiners clay, both of small extent in the project area. The bulk of the Pleistocene deposits are till and outwash sequences associated with two ice advances within the Wisconsin stage. Shoreline, swamp, and alluvial deposits of Recent age locally mantle the older deposits.

The unconsolidated sediments, saturated with water from the weathered bedrock upward to the water table, yield water to wells screened in the more permeable zones. The water-bearing characteristics of geologic formations in northwestern Nassau County and northeasthern Queens County are summarized in table 2. Logs and geologic correlations for selected wells and test borings are given in table 12.

GEOLOGIC FORMATIONS AND THEIR WATER-BEARING PROPERTIES

PRECAMBRIAN BEDROCK

Bedrock occurs at depths ranging from about 200 to 800 feet below sea level. Descriptions of cores from wells indicate that it is generally a biotite schist or gneiss, which may be intruded by granite or pegmatite. In most places the bedrock is strongly weathered in its upper part, the weathered zone being several tens of feet thick. Well N4266, in Great Neck, penetrated 71 feet of weathered bedrock without reaching fresh rock. (See log N4266, table 12.) Weathered bedrock may consist largely of textureless residual clay, with interspersed mineral grains, and may thus be mistaken for a clay stratum.

The configuration of the crystalline bedrock surface is important in that it defines, for practical purposes, the lower limit of the groundwater reservoir on Long Island. Contours drawn on the buried

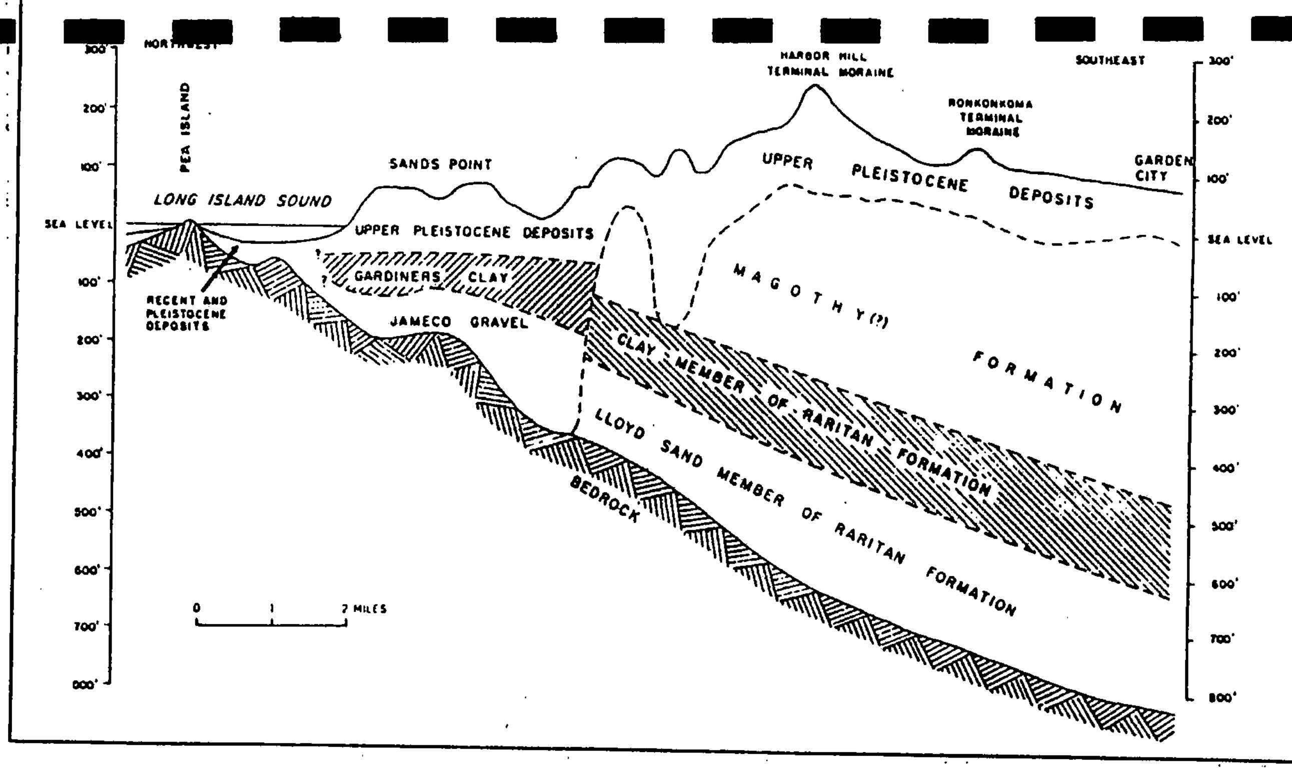

FIGURE 4.—Generalized section showing stratigraphic units in northwestern Nassau County, N.Y.

0-186—63—2

TABLE 2.—*Summary of stratigraphy and water-bearing properties of the deposits underlying northwestern Nassau and northeastern Queens Counties, N.Y.*

System	Series	Geologic unit	Approximate thickness (feet)	Depth from land surface (feet)	Character of deposits	Water-bearing properties
Quaternary	Recent	Recent deposits: Artificial fill, salt-marsh deposits, swamp deposits, stream alluvium, and shoreline deposits	0-50	0	Sand, gravel, silt, and clay; organic mud, peat, loam and shells. Colors are gray, black, and brown.	Permeable zones near the shoreline or in stream valleys may yield small quantities of fresh or brackish water at shallow depths. Clay and silt beneath the north-shore harbors retard salt-water encroachment and confine underlying aquifers.
	Pleistocene	Upper Pleistocene deposits: Harbor Hill drift	20-200	0-50	Till, composed of unsorted clay, sand, and boulders, present in Harbor Hill terminal moraine and, as ground moraine, in area adjacent to north. Outwash deposits of stratified brown sand and gravel, including advance outwash and kame-delta, kame-terrace, outwash-plain and other late glacial deposits.	Till, relatively impermeable, may cause local conditions of perched water and impede downward percolation of precipitation. Outwash deposits of sand and gravel are highly permeable. Wells screened in glacial outwash deposits, generally at depths of less than 130 ft, yield as much as 1,400 gpm to wells. Specific capacities of wells range from 5 to 57 gpm per ft of drawdown. Water is generally fresh and unconfined.
		Upper Pleistocene deposits: Ronkonkoma drift	0-120	20-200	Till, composed of unsorted clay, sand, and boulders, present in Ronkonkoma terminal moraine and, as buried ground moraine, in an area extending northward into Manhasset Neck. Outwash deposits of stratified brown sand and gravel, including proglacial deposits from Ronkonkoma ice sheet.	
		Unconformity?				
		Gardiners clay	0-200	60-170	Clay and silt, gray-green, some lenses of sand and gravel. May contain shells, foraminifera and lignite. Interglacial deposits. Altitude of surface generally between 50 and 80 ft below mean sea level.	Relatively impermeable. Confines water in underlying Jameco gravel. Lenses of sand and gravel may provide small sources of water supply and may permit local interchange of water with adjacent formations.
		Unconformity?				
		Jameco gravel and undifferentiated Pleistocene deposits	0-200	120-350	Sand, fine to coarse, gray and brown, and gravel. May contain clay and silt layers. Probably early glacial outwash deposit. Undifferentiated Pleistocene valley fill, consisting of sand, gravel, and clay; may be in part equivalent to Jameco gravel.	Moderately to highly permeable. Yields as much as 800 gpm to wells. Specific capacities are commonly between 10 and 20 gpm per ft of drawdown. Constitutes only source of large supplies of water in parts of Manhasset and Great Necks. Water is confined under artesian pressure. Generally contains fresh water but may have high iron content; locally may contain brackish water.
		Unconformity				

Cretaceous	Upper Cretaceous	Magothy(?) formation	0–400	5–200	Sand, fine to medium, clayey, gray, white, with pink, and yellow. Interbedded with lenses and layers of coarse sand and sandy and solid clay. Gravel generally in lower 50 to 100 ft of formation. Lignite, pyrite, and iron oxide concretions are common throughout formation.	Moderately to highly permeable. Wells screened in basal zone of formation yield as much as 1,400 gpm. Specific capacities range commonly from 15 to 30 gpm per ft of drawdown, but may be as high as 50. Formation is principal source for public supply. Water is generally of excellent quality. Degree of confinement under artesian pressure is variable; however, artesian conditions generally prevail in the deeper part of the formation. Hydraulic continuity may exist between the Magothy(?) formation and contiguous Pleistocene valley fill.
		Unconformity				
	Raritan formation	Clay member	0–200	100–500	Clay, solid and silty, gray, white and red. May contain lenses or layers of sand and gravel. Lignite and pyrite are abundant.	Relatively impermeable. Retards but does not prevent movement of water between the Magothy(?) formation and the Lloyd sand member.
		Lloyd sand member	0–200	350–700	Sand, fine to coarse, white, gray, or yellow and gravel, commonly in clayey matrix. Contains lenses and layers of solid or silty clay.	Moderately permeable. Wells yield as much as 1,600 gpm; specific capacities range commonly from 10 to 20 gpm per ft of drawdown. Constitutes only source of large supplies in parts of Great and Manhasset Necks. Water is confined under artesian pressure; some wells flow. Water is generally of excellent quality but may have high iron content.
		Unconformity				
Precambrian		Bedrock	....	180–900	Crystalline metamorphic and igneous rocks; muscovite-biotite schist, gneiss, and granite. Weathered zone at top may be as much as 70 ft thick.	Relatively impermeable. Contains some water in fractures, but impracticable to develop owing to low permeability.

bedrock surface (pl. 2) show the general southeasterly slope of the basement rocks at about 50 feet per mile. However, there are indications that this regional slope is reversed locally in the northern part of Manhasset and Great Necks. For example, well data indicate a leveling or a reversal of bedrock slope in Sands Point, Port Washington, and Kings Point. (See also geologic sections shown on pls. 4–6.) Channel cutting to a depth slightly greater than 350 feet below present sea level seems to have occurred during a pre-Wisconsin stage of the Pleistocene when sea level was perhaps 400 feet lower than at present. Erosion at that time appears to have removed the bulk of Cretaceous deposits in the northernmost areas of Great Neck and Manhasset Neck. Undoubtedly there are other variations in the relief of the bedrock surface, which might be revealed by exploratory drilling. In a seismic study of the Long Island area, Oliver and Drake (1951) found indications of relief of about 200 to 300 feet on the crystalline rock surface.

Although small quantities of water are obtained from bedrock wells in the extreme western part of Long Island, no ground-water withdrawals by bedrock wells are made in the project area.

UPPER CRETACEOUS SERIES

Deposits of Late Cretaceous age on Long Island lie unconformably above bedrock and consist of interbedded sand, gravel, silt, and clay which are dominantly of terrestrial origin. Two formations are recognized: the older Raritan formation, which is divided into the Lloyd sand member below and the clay member above, and the younger Magothy(?) formation. The Raritan formation, by correlation with New Jersey formations, has been referred to the basal part of the Upper Cretaceous series. The term Magothy(?) formation, used to designate all Cretaceous strata on Long Island that lie above the Raritan formation, probably includes an equivalent of the Magothy formation of New Jersey and also some Upper Cretaceous strata younger than the Magothy of New Jersey (Perlmutter and Crandell, 1959, p. 1066).

The Cretaceous deposits, sloping to the southeast, are known almost entirely from well logs. They attain their greatest thickness in the vicinity of Garden City. Here the Createceous, beginning at about sea level and extending to 800 feet below, is divided almost equally between the Raritan and Magothy(?) formations. The distribution of Cretaceous deposits is shown by a contour map on the buried Cretaceous surface (pl. 3) and geologic sections (pls. 4–7). The location of geologic sections and Cretaceous outcrops are shown in plate 8.

RARITAN FORMATION

LLOYD SAND MEMBER

The Lloyd sand member of the Raritan formation, lying on bedrock, is about 150 to 200 feet thick. The top of the Lloyd ranges in depth from about 250 feet below sea level in the center of Manhasset and Great Necks to about 600 feet below sea level in the southeastern part of the project area. The Lloyd sand member is composed of white, yellow, or gray sand and gravel, which in many places has a clayey matrix. The coarse fraction consists entirely of quartz and chert fragments, which are subangular to subrounded, and a small percentage of stable accessory minerals. Although lenses of clay and clayey sand are fairly common, the Lloyd sand member is a relatively permeable artesian aquifer in almost the entire project area. It is absent in Manhasset and Great Necks, where it has been replaced by the Jameco gravel which is hydraulically connected with the Lloyd sand member to the south. These contiguous formations constitute the deep confined aquifer which is discussed beyond. Wells screened in the Lloyd sand member yield as much as 1,600 gpm (gallons per minute). Specific capacities range commonly from 10 to 20 gpm per foot of drawdown. Theis and others (1954) developed a method of estimating permeability from specific capacity. By application of this method, permeabilities (See Wenzel and Fishel, 1942, p. 7 for definition of coefficient of permeability) for the Lloyd sand member were obtained, as shown in table 3.

TABLE 3.—*Estimated permeabilities of materials in Lloyd sand member of Raritan formation*

Well	Screened zone (feet below land surface)	Specific capacity (gpm per ft)	Approx. aquifer thickness (feet)	Estimated permeability (gpd per sq ft)
N23	404–434	10	140	200
24	360–428	16	150	270
[illegible]291	376–401	5	40	300
[illegible]328	652–742	26	210	330
[illegible]18	470–550	21	150	380
1715	430–480	11	140	210
1802	641–691	19	190	260
[illegible]58	667–727	31	150	560
[illegible]02	436–467	12	80	370

CLAY MEMBER

The clay member of the Raritan formation, lying above and confining the Lloyd sand member, is the chief aquiclude or confining bed within the ground-water reservoir of the project area. It consists of about 100 to 200 feet of relatively impermeable solid and silty clay, usually dark gray, and lignitic zones. Colors are variable and include red, white, and variegated. Gravelly strata and calcareous concretionary zones also have been reported. The top of the clay member is about 100 to 150 feet below sea level in the northern peninsulas, and the clay member slopes to the southeast at a rate similar to that of the bedrock surface. The northern limit of the clay member coincides with the boundaries of the Cretaceous deposits shown in plate 3. Locally, at depths of less than 100 feet below sea level, parts of the clay member apparently were deformed and displaced by Pleistocene ice, and their stratigraphic position is doubtful. Stratigraphic correlation is further complicated by the fact that clay strata of similar lithology, for which no identifying criteria have been found, occur in both the Raritan and Magothy(?) formations. Facies changes within the clay member of the Raritan formation are indicated in two areas, particularly along the shores of Hempstead Harbor and in Port Washington, where silt and clayey sand, rather than solid clay, are dominant. Columnar plots for wells N6346, N662, and N2002, along Hempstead Harbor, are shown on geologic section *D–D′*, plate 7. In Port Washington, toward its northern limit, the clay member consists of about 30 feet of solid clay at the top, which is underlain by clayey sand and sand. There is no marked change in lithology as the underlying Lloyd sand member is penetrated. (See columnar plot and electric log of well N5530, pl. 5, and test boring N6089T, pl. 6).

MAGOTHY(?) FORMATION

The Magothy(?) formation is slightly more than 400 feet thick at the maximum; its upper surface is more than 100 feet above sea level locally in Port Washington and Manhasset. The formation consists chiefly of fine micaceous sand, sandy clay, and clay. The colors are usually gray, white, pink, or red; lignite, pyrite, and iron oxide concretions are common throughout. Gravel occurs in a zone near the bottom and in lenses at somewhat higher altitudes. As in the Lloyd sand member, the sand and gravel of the Magothy(?) consist essentially of quartz and chert and small amounts of stable heavy and opaque minerals. Common accessory minerals include garnet, tourmaline, zircon, rutile, and kyanite. Although the Magothy(?) formation is characteristically lenticular and may locally consist almost entirely of fine clayey sand and silt, its more permeable zones yield by far the greatest share of the water pumped in the project area. Many of the larger wells screened in the basal part of the formation are pumped at rates of 1,000 to 1,400 gpm; specific capacities commonly range from 15 to 30, but may be as high as 50. Estimated permeabilities of materials from the Magothy(?) formation, computed from specific capacities of wells, range from 270 to 870 gpd (gallons per day) per square foot as shown in table 4.

TABLE 4.—*Estimated permeabilities of materials in Magothy(?) formation*

Well	Screened zone (feet below land surface)	Specific capacity (gpm per ft)	Approx. aquifer thickness (feet)	Estimated permeability (gpd per sq ft)
N-16	378–438	19	150	280
17	405–465	11	80	350
2028	425–485	28	190	400
2030	190–215	14	80	440
5209	260–300	20	100	540
5884	92–163	37	110	870
5876	168–238	11	110	270

The stratigraphic position of the Magothy(?) is shown on four geologic sections (pls. 4–7). The areal extent and relief of the eroded and buried Cretaceous surface is shown by a contour map (pl. 3). Generally the contours are drawn on the Magothy(?) surface except in some major valleys where the formation may be absent entirely. In this case, the contours represent the top of the eroded Raritan formation, most commonly the clay member. Cretaceous deposits underlie almost the entire area, except in the northern tips of Manhasset and Great Necks. In Kings Point and Sands Point the northern limit of the Cretaceous is marked by a buried cuesta apparently formed in the clay member of the Raritan formation at or below sea level. Quite possibly this cuesta originated as the obsequent north-facing slope of a strike valley cut to or nearly to bedrock in Tertiary time. Erosion in early Pleistocene time probably removed all Cretaceous sediments in the northern part of the peninsulas, leaving isolated remnants to the east and west and probably in the wider parts of Long Island Sound.

The relief of the Cretaceous surface, moderate in the southern part of the area but more pronounced in the north, was created by post-Cretaceous consequent streams draining toward the Atlantic Ocean. Obsequent streams flowing into the strike valley now forming Long Island Sound were responsible for the initail relief in the Cretaceous surface along the north shore. The present north-shore bays and harbors presumably owe their origin to obsequent streams. Pleistocene erosion seems to have been a strong contributing factor in producing more than 400 feet of relief in the Port Washington area and possibly elsewhere. The irregularities of the Cretaceous surface are revealed only locally and fortuitously by well-drilling data.

PLEISTOCENE SERIES

Deposits of Pleistocene age locally may comprise all or most of the unconsolidated sediments above bedrock and they assume special importance wherever they are part of the ground-water reservoir. Almost everywhere, the Pleistocene sand, gravel, and till form the surficial deposits and, because of their variable permeability, determine the rate at which precipitation infiltrates to the main ground-water body. A special effort was made, therefore, to recognize the various glacial and interglacial deposits at the surface and in wells and to establish their age relationships. From his own observations, and in accordance with the opinions expressed by other writers (Fleming, 1935; Flint, 1957; MacClintock and Richards, 1936), the writer favors a simpler sequence of Pleistocene events than that offered by Fuller (1914). Accordingly, the deposits of Pleistocene age are referred to two glacial stages, separated by an interglacial marine deposit, the Gardiners clay. The pre-Wisconsin deposits, consisting of the Jameco gravel and Gardiners clay, have been recognized only in some wells along the north shore. The bulk of the Pleistocene deposits, collectively known as the upper Pleistocene deposits, are presumably of Wisconsin age. In the project area they have been grouped into the Ronkonkoma and Harbor Hill drifts. The surficial deposits of the area are shown in plate 8.

JAMECO GRAVEL AND UNDIFFERENTIATED DEPOSITS OF PLEISTOCENE AGE

The oldest glacial deposit in the project area, probably the Jameco gravel, consists of sand, gravel, and silt lying on bedrock or in valleys cut into the Cretaceous sediments. The deposit apparently is largely glacial outwash from an ice sheet that did not reach Long Island. However, the ice front might have been close to the present north shore (Veatch and others, 1906, p. 34). In the absence of older Pleistocene deposits of known age in the New England-New York area with which it might be correlated (See glacial map of the United States east of the Rocky Mountains, Flint and others, 1959) the Jameco gravel can be dated only as of pre-Sangamon, possibly Illinoian age. Much of the Jameco gravel apparently has been deposited by melt-water streams from different source areas to the north and northwest of Long Island. In contrast to the heterogeneous composition of the formation in the type locality in Queens, the Jameco gravel in the project area seems to be derived largely from Cretaceous sources and contains only a small admixture of igneous rock pebbles or other erratic material. As in the younger outwash deposits, pebbles of granitic and metamorphic texture may be very slightly or strongly weathered, according to their schistosity or content of micaceous minerals. The Jameco lies from about 150 to 350 feet below sea level in nearshore areas and probably under parts of Long Island Sound and its bays. It is found principally to the north of the limit of the Cretaceous, but also in some valleys cut into the Cretaceous. Commonly it is between 100 and 200 feet thick. (See pls. 4–7.) Because of lithologic similarity to the Cretaceous and the overlying younger outwash deposits, the Jameco gravel on the north shore of Long Island is not readily identified from well-drillers' samples. Commonly it is recognized only where it is overlain by the Gardiners clay.

Undifferentiated Pleistocene valley fill, consisting largely of sand and gravel, is found also in some of the deeper valleys cut into or through the Magothy(?) formation. (N3521T and N4223T, pl. 7; N5710, pl. 4.) Although this valley fill occurs at somewhat higher altitudes inland, it may be in part equivalent to the Jameco gravel. In most cases it cannot be positively identified.

The Jameco gravel is part of the deep confined aquifer in Sands Point, Port Washington, and Great Neck where locally it is the only source of large supplies of water. Specific capacities of wells screened in the Jameco gravel commonly are less than those wells tapping other aquifers (table 11). Estimated permeabilities, computed from specific capacities, range from 140 to 330 gpd per sq ft. Somewhat greater permeabilities were obtained for undifferentiated Pleistocene valley fill, as shown in table 5.

TABLE 5.—*Estimated permeabilities of Jameco gravel and undifferentiated Pleistocene valley fill*

Well	Screened zone (feet below land surface)	Specific capacity (gpm per ft)	Approx. aquifer thickness (feet)	Estimated permeability (gpd per sq ft)
Jameco gravel				
N-33	239–340	9	100	240
35	287–387	19	150	330
38	382–396	5	90	140
675	269–286	7	100	190
Undifferentiated Pleistocene valley fill				
N-3540	103–155	13	140	250
3742	230–260	23	160	340
4223	277–330	34	200	425

GARDINERS CLAY

A marine formation occurring close to the north shore, in present embayments and former channels, has been recognized in many wells in Great and Manhasset Necks. The formation is correlated with the Gardiners clay. It consists of greenish-brown clay and silt and scattered sand or gravel lenses. Some zones contain plant debris, ranging from fairly fresh to lignitic. The top of the formation usually lies between 50 and 60 feet below sea level; the thickness is variable but commonly ranges from 100 to 200 feet. The formation is in part fossiliferous, containing fragments of oyster and clam shells and, commonly, Foraminifera. Of the latter, *Elphidium* is the most common genus. A fossiliferous zone of some continuity occurs within the Gardiners clay between 80 and 100 feet below sea level in the northern part of Manhasset Neck. (Test borings N4389T and N6095T, pl. 6; also N33, N1482, and N4859T, pl. 5.) No systematic study of the fossil material was possible during the present investigation. Only a detailed ecological study of the microfauna might give some clues as to the depositional environment of the Gardiners clay of the north shore, including salinity, depth, and temperature ranges. In lithology the Gardiners clay of northwestern Nassau County resembles closely the formation in other parts of Long Island and may in part represent deposition in shallow, brackish water (Weiss, 1954). Nearshore deposition is indicated by vegetable debris and gravelly zones within the clay.

The Gardiners clay was deposited at a time when sea level was perhaps 50 feet lower than at present. Its age and general correlation with the Gardiners clay of Cape Cod are dubious. The formation probably is of interglacial, pre-Wisconsin origin, although an early Wisconsin interstadial age is not impossible (Flint, 1957, p. 359; Hyyppä, 1955, p. 211). Carbon^{14} dates obtained for oyster shells from two localities (Port Washington and Glen Cove) representing the Gardiners clay apparently indicated an age greater than 38,000 years. Radiocarbon age determinations of the samples obtained from outcrops, were made in the laboratory of the U.S. Geological Survey. (Meyer Rubin, written communication, 1957.)

Lab no. and date of analysis	Description	Age (years)
W-611, Oct. 1, 1957	Oyster shells from gray marine clay incorporated in till, exposed in stream bed of Plandome-Port Washington drain, Nassau Knolls Cemetery, Port Washington, N.Y.	>38, 000
W-613, Oct. 1, 1957	Shell fragments from marine deposit below till and outwash on east shore of Hempstead Harbor 1,000 ft south of E. M. Loew estate, Glen Cove, N.Y.	>38, 000

In spite of uncertainties as to its age and origin, the Gardiners clay, because of its fossil content, is a valuable key horizon in the Pleistocene stratigraphy. Previously unpublished logs of wells in which the Gardiners clay has been recognized are included in table 12. Geologic correlations for several wells, given in Suter and others (1949), are revised in the following table to include the Gardiners clay and Jameco gravel units.

TABLE 6.—*Geologic correlation of strata in some wells in northwestern Nassau County, N.Y.*

[The boundaries of geologic units are given in feet above or below mean sea level]

Well	Location	Total depth drilled (feet)	Recent and upper Pleistocene deposits		Gardiners clay		Jameco gravel		Magothy(?) formation		Raritan formation: Clay member		Raritan formation: Lloyd sand member		Bedrock	
			From	To	From	To	From	To	From	To	From	To	From	To	From	To
N33	Port Washington	369	+20	−57	−57	−212	−212	−345	....	....	....	....	....	....	−345	−349
N36	Sands Point	280	+40	−50	−50	−100	−100	−185	....	....	....	....	....	....	−185	−240
N37	do	220	+45	−55	−55	−70	−70	−174	....	....	....	....	....	....	−174	−175
N39	do	138	+5	−50	−50	−122	−122	−133	....	....	....	....	....	....	....	....
N662	Port Washington	308	+11	−52	−52	−188	−188	−235	....	....	−235	−336	−336	−356	....	....
N675	do	290	+10	−62	−62	−246	−246	−280	....	....	....	....	....	....	....	....
N1482	do	151	+11	−46	−46	−140	....	....	....	....	....	....	....	....	....	....

The top of the Gardiners clay commonly is recognized with difficulty, particularly where the formation is overlain directly by fossiliferous marine clays of Recent age. Also, in many places along the north shore the Gardiners has been deformed by the thrusting action of later Pleistocene ice advances and thus may be above sea level. Large masses of the formation were found to be incorporated in the lower of two till sheets in Port Washington, at elevations ranging from a few feet below to 150 feet above sea level.

The Gardiners clay apparently is present in Great Neck, Kings Point, Sands Point, and Port Washington: it may be present also in the north-shore bays and parts of Long Island Sound, where it is dissected by subsequent Pleistocene and Recent erosion. Although the formation is variable enough in thickness and lithology to permit local interchange of water with adjacent formations, it generally constitutes a confining bed creating artesian conditions in the underlying Jameco gravel. Very few wells tap the more permeable zones within the Gardiners and thus yield small supplies of water.

UPPER PLEISTOCENE DEPOSITS

The term upper Pleistocene deposits was introduced by deLaguna (1948) for all glacial deposits above the Gardiners clay on Long Island. These deposits, presumably of Wisconsin age, consist of stratified drift, till, and some silt and clay of lacustrine origin. Their greatest thickness is in the area of the terminal moraines, where it may reach 200 to 300 feet. In large part, the upper Pleistocene deposits appear to be related to two ice advances, and they are subdivided in the project area, wherever feasible, into the Ronkonkoma and Harbor Hill drifts. Each of these drifts is composed of a terminal moraine and related till and outwash deposits. The older Ronkonkoma drift is recognized from the Ronkonkoma terminal moraine northward, in most of Manhasset Neck. The Ronkonkoma drift is mantled thinly by outwash gravel between the terminal moraines, but from the Harbor Hill terminal moraine northward the Ronkonkoma drift generally is buried by 30 to 150 feet of Harbor Hill drift. Most of the area's surficial deposits, shown in plate 8, are associated with the Harbor Hill ice invasion. The relationship of the Harbor Hill and Ronkonkoma drifts to the older deposits is indicated on geologic section *C–C′*, plate 6.

Although the bulk of the upper Pleistocene deposits lies above the zone of saturation in much of the project area, the permeable sand and gravel deposits of the Ronkonkoma and Harbor Hill drifts yield water to many wells in areas where the Magothy(?) formation occurs at low altitudes or has been eroded. The upper Pleistocene deposits constitute an important source of water in Great Neck, Sands Point, northeastern Queens, and particularly the area of the outwash plain south of the Ronkonkoma and Harbor Hill terminal moraines. Wells screened in the glacial outwash deposits, generally at depths of less than about 130 feet, yield as much as 1,400 gpm. The specific capacities of these wells, commonly between 40 and 60 gpm per foot of drawdown, generally are greater than those of wells tapping Cretaceous formations (table 11). Permeability coefficients of the outwash materials commonly range from about 800 to 1,000 gpd per sq. ft. and, exceptionally, may be as great as 2,000 gpd per sq. ft. (N15, table 11). Relatively impermeable till, associated with both moraines at the surface and at depth occurs north of the outwash plain; it may cause perched-water conditions or retard infiltration of precipitation. (See p. 29.)

RONKONKOMA DRIFT

The Ronkonkoma drift, consisting of a terminal moraine of the same name and related outwash deposits and till, rests upon the Magothy(?) and early Pleistocene deposits. The Ronkonkoma terminal moraine is relatively indistinct in western Nassau County, where it is largely mantled by younger outwash and rises but slightly above the surrounding pitted outwash plain. However, it can be traced westward from Albertson to Lake Success, where it merges with the Harbor Hill terminal moraine. (See pl. 8.) A sheet of till, recognizable in many wells, and apparently fairly continuous, has been traced beneath younger drift southward from Manhasset Neck to the position of the Ronkonkoma terminal moraine (wells N3732, N5947, and others, shown on section *C–C′*, pl. 6). This till sheet is generally 10 to 20 feet thick and consists of compact clayey or sandy boulder till. The top of the till generally is at altitudes slightly above 100 feet but may be as high as 150 to 170 feet above sea level. In many places the till is highest where the Cretaceous surface is high; and these highs coincide also with some of the highest altitudes along the younger Harbor Hill terminal moraine. The till, extending southward from Manhasset Neck and Harbor Hill to North Hills and Albertson, is correlated here with the older till exposed in several gravel pits on the west shore of Hempstead Harbor at altitudes of about 100 feet above sea level. The till and the underlying outwash gravel, respectively the Montauk till member and the Herod gravel member of the Manhasset formation described by Fuller (1914, p. 114) are interpreted here as the ground moraine and advance outwash deposits of the Ronkonkoma ice invasion.

HARBOR HILL DRIFT

The Harbor Hill drift consists of a terminal moraine, a veneer of ground moraine, and various outwash deposits related to the advance, stagnation, and waning of the latest, or Harbor Hill, ice; their distribution is shown in plate 8. Stratified sand and gravel deposits above the Ronkonkoma drift or, as in Great Neck, directly upon the Cretaceous, apparently represent advance outwash from the Harbor Hill ice. These deposits, generally 20 to 50 feet and in places as much as 80 feet thick, probably include the Hempstead gravel member of the Manhasset formation described by Fuller. They were well exposed in several gravel pits on Manhasset Neck in 1957. (See pl. 8.) North of the Harbor Hill Terminal moraine, these outwash deposits are covered by a veneer of ground moraine, usually a clayey or sandy till containing boulders; it is generally 5 to 10 feet but locally as much as 40 feet thick and in places very compact. The Harbor Hill terminal moraine, a distinct northeast-trending ridge, consists largely of ice-contact deposits which, in their alignment, indicate the position of an ice front that was stable for a considerable time. Isolated or coalescing kames and interspersed kettle holes account for the irregular surface of the moraine. Steeply inclined, crudely stratified sand and gravel deposits showing slump and collapse features are characteristic in the area. Till is generally present within the Harbor Hill terminal moraine but highly irregular in distribution and thickness. The morainal ridge is breached in several places by melt-water channels which continue the southerly trend of the north-shore bays. The channel fill consists of stratified sand and gravel, presumably of late-glacial or early post-glacial age. Other stratified deposits associated with the waning stages of the Harbor Hill ice include kame deltas and kame terraces on Manhasset and Great Necks, as shown in plate 8. A glacial outwash plain of stratified sand and gravel slopes southward from the terminal moraine. The surface of this plain is somewhat irregular and pitted by kettle holes as far south as the Ronkonkoma terminal moraine, but the surface becomes relatively smooth farther south.

AGE OF THE UPPER PLEISTOCENE DEPOSITS

No evidence is available that would justify the subdivision of Long Island's upper Pleistocene deposits into units representing more than one glacial stage. All deposits above the Gardiners clay seem to be closely related to the two ice advances that produced the Ronkonkoma and Harbor Hill terminal moraines. There are no significant erosional intervals or fossil-soil development anywhere in the upper Pleistocene sequence; there are no obvious lithologic differences between the oldest and youngest outwash deposit and there is no difference in the degree of weathering of rock pebbles in till or outwash that can be attributed readily to variations in mineral composition and texture. Thus, apparently no great time elapsed between the Ronkonkoma and Harbor Hill ice advances, which, therefore, might be considered episodic within one glacial stage. MacClintock and Richards (1936, p. 336) and Flint (1957, p. 356) also consider the Pleistocene deposits of Long Island above the Gardiners clay to be of Wisconsin age.

RECENT SERIES

Deposits of Recent age are found along the shorelines, in stream valleys, in swamps and marshes, and offshore (pl. 8). The deposits include sand and gravel on beaches and bars, a minor amount of silty alluvium deposited by streams, and organic silt in fresh-water swamps and peat bogs. Some of the peat bogs occupy depressions underlain by till and apparently represent sites of more or less continuous accumulation of lake sediments and peat since early post-glacial time. A large deposit of peat in the southeastern part of Manhasset Neck is as much as 18 feet thick. Swamp and peat deposits also are extensive in Kings Point and along the Ronkonkoma terminal moraine, north of Garden City Park. A radiocarbon age of approximately 5,300 years was determined in the laboratory of the U.S. Geological Survey (Rubin, Meyer, written communication, 1959) for a peat sample obtained directly above the youngest till on Manhasset Neck.

Lab no. and date of analysis	Description	Age (years B.P.)
W–716, June 3, 1959.	Plant debris, partly lignitized, in contact with till, depth 5 ft. From humus and peat deposit which overlies youngest till (ground-moraine) in area. Property of Landuhl Co., West Shore road, south of Colonial Sand and Stone Co. gravel pit, Flower Hill Estates, Port Washington, N.Y.	5, 310 ± 240

Of particular hydrologic importance are the silt and clay now accumulating in the north-shore bays and Long Island Sound. Although these deposits, several tens of feet thick, may contain intercalated gravel lenses, they generally are impermeable enough to retard leakage of fresh water from the underlying strata into the bays. Because of their relatively small extent and common association with salt water, the deposits of Recent age do not constitute a major source of water.

SUMMARY OF THE GEOLOGIC HISTORY

Detailed descriptions of Long Island's geologic history were written by Fuller (1914, p. 192) and deLaguna (*in* Suter, 1949, p. 29). Although the knowledge of geologic events in the Long Island area is incomplete, a review of known events helps in understanding the areal extent and nature of the geologic formations. Reference to the distribution and lithologic character of the formations, as these factors affect the occurrence of ground water in the project area, has been made in the preceding pages. Therefore, only a summary of geologic events applicable to western Long Island and the project area is given below.

Subaerial erosion, beginning in the late Triassic and extending into Jurassic time, reduced the Long Island area to a plain of low relief, the so-called Fall Zone peneplain. This plain, which was cut into crystalline and sedimentary rocks, was slightly above sea level. Uplift of a large sector of the earth's crust in eastern North America, in early to mid-Cretaceous time, centered along the axis of the Appalachian Mountains. This uplift was accompanied by gentle tilting of the Fall Zone peneplain to the southeast, depressing the Long Island area while elevating the land to the west and north. Erosion of the newly created highlands provided the sediments which were deposited in the Long Island area as the Raritan and Magothy(?) formations of Late Cretaceous age. Most of these sediments indicate a coastal-plain environment of deposition, either in stream channels and on flood plains along the lower reaches of streams, or in shallow water offshore. The period of deposition, representing tens of millions of years, was sufficiently long to include major oscillations of the shoreline. Thus, cycles of deposition were interrupted by periods of relatively more intense erosion. Renewed tilting of the bedrock to the southeast is inferred from the thickening of the formations southeastward.

Presumably the sea receded from the area that is now Long Island near the close of the Cretaceous, and erosion was dominant during much of Tertiary time. The uplifted Cretaceous sediments were dissected by consequent southward-flowing streams and their tributaries. The tributaries eventually became major subsequent streams, following outcrop areas of relatively less competent strata. The present depression of Long Island Sound apparently had its origin in a subsequent valley eroded along the contact of the Lloyd sand member of the Raritan formation with the crystalline bedrock to the north. The southern boundary of the depression was a cuesta-like ridge of hills interrupted by transverse valleys. The cores of these hills were composed of the more erosion-resistant clay member of the Raritan formation.

No definite evidence of early Tertiary strata has been found on Long Island. However, by analogy with strata in the central and southern parts of the Atlantic Coastal Plain, post-Cretaceous marine strata may be expected to exist seaward of the Raritan and Magothy(?) formations, near the present south shore of Long Island (Perlmutter and Crandell, 1959, p. 1066). Tertiary deposits also may exist on the island in some of the major buried valleys which are not well defined at the present time. A gravel deposit capping the Mannetto Hills, the Mannetto gravel of Fuller (1914) has local distribution in eastern Nassau and western Suffolk Counties but has not been recognized in western Long Island. Fuller (1914, p. 85) suggests that this deposit may be of early Pleistocene age, but Crosby (unpublished report, 1910, p. 52) states that it may be of Pliocene age.

A pre-Wisconsin stage of Pleistocene glaciation is represented by the Jameco gravel, an outwash deposit from an ice sheet which presumably did not reach Long Island. The stratigraphic position of the Jameco gravel indicates that sea level was perhaps 350 to 400 feet lower than at present. As a result, accelerated erosion may have re-excavated or deepened some of the pre-existing Tertiary valleys and also cut some new valleys. This erosion probably also removed much of the remaining Cretaceous and Tertiary deposits from some areas of Long Island Sound and its tributary valleys, while the Jameco gravel was being deposited in other areas. Much of the Jameco gravel in the project area is apparently eroded from Cretaceous sources and was redeposited by melt water streams.

The next event in Long Island's geologic history is recorded by the Gardiners clay, a marine formation, which overlies the Jameco gravel in the project area and also in the southwestern part of the island. The interglacial (Sangamon?) Gardiners clay probably was deposited when sea level was about 50 feet below its present position.

The beginning of the Wisconsin glacial stage presumably was accompanied by a renewed lowering of sea level and erosion of the Gardiners clay. However, the relatively shallow depth of erosional channels in the Gardiners in western Long Island seems to indicate a position of sea level perhaps 100 to 150 feet lower than at present. Eustatic lowering of sea level, brought about by retention of moisture from the oceans in continental ice masses, probably was as much as 290 to 380 feet (Flint, 1957, p. 260). Isostatic adjustments to the weight of the superimposed ice or to its removal have not been recognized in Long Island. Such crustal movements were probably small or negligible in the area marginal to the continental ice sheets and would tend to decrease the total amount of relative emergence or submergence. The position of an ice front that was stable for considerable time in the Long Island area is marked by the Ronkonkoma terminal moraine.

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Associated with the ice invasion are advance outwash, ice-contact deposits, and till, described collectively as Ronkonkoma drift (p. 45). Ice shove produced strong deformation of the Gardiners clay and older formations along the entire north shore of Long Island and locally incorporated large masses of these materials in the drift. The Ronkonkoma ice front subsequently retreated an unknown distance to the north of Long Island, then apparently readvanced to another position of relative stability marked by the Harbor Hill terminal moraine. Various outwash deposits and till (Harbor Hill drift, p. 46) are related to the advance, stagnation, and waning of the latest, or Harbor Hill, ice in the area. Glacial lakes were formed in some depressions along the north shore of Long Island during the wasting stages of both ice invasions. In post-glacial time erosion and deposition proceeded under conditions of fluctuating sea level. Recent sediments accumulated in some of the Pleistocene valleys and north-shore bays, and sea level rose to its present position in the most recent past.

HYDROLOGY

GROUND WATER

GENERAL FEATURES

The ultimate source of the ground water is precipitation. Of the total precipitation, part returns directly to the atmosphere, part infiltrates the ground, and part runs off overland in streams draining into Long Island Sound or the ocean. Much of the water moving downward into the soil and subsoil is retained at shallow depth as soil moisture, which is subject to evaporation and the demands of plant growth. During the summer, evapotranspiration may return moisture to the atmosphere at rates similar to or exceeding those of precipitation. During the remainder of the year, water available after the soil-moisture requirements have been met moves down through the Pleistocene and Cretaceous strata to the water table and becomes ground water. Some of the water eventually reaches the deeper strata by downward percolation—chiefly from the main area of recharge on the ground-water divide in the southeastern part of the project area and locally from areas of recharge on Manhasset and Great Necks. Ground water discharges by upward leakage from the deeper strata along the coast, offshore, in springs along the shores, and by ground-water outflow in the lower reaches of stream valleys.

Unconsolidated deposits of Cretaceous and Pleistocene age form the bulk of the ground-water reservoir. The intergranular space of all these deposits is saturated from the weathered bedrock upward to the water table, which represents the upper limit of the zone of saturation. Where the upper part of the zone of saturation is in permeable beds, ground water is unconfined or under water-table conditions. Ground water confined under pressure beneath relatively impermeable strata is called confined or artesian. The water may be under sufficient pressure to flow at the land surface, where tapped by a well. Flowing wells are common near the shores of some bays and harbors leading into Long Island Sound.

Ground water in the project area is under virtually all degrees of confinement, ranging from water-table to artesian. Also, locally, bodies of ground water are perched above the main water table and separated from it by an intervening unsaturated zone. Ground water is perched where the downward migration of water is impeded by a relatively impermeable stratum, which results in a local zone of saturation unrelated to the main water table.

All the water in the ground-water reservoir can be considered to constitute a single hydraulic system, but the more permeable zones within the reservoir are called aquifers. An aquifer is a discrete hydrological unit that is capable of yielding water to wells or springs in substantial quantities; it may be comprised of one formation, part of a formation, or group of formations. Impermeable strata in the reservoir that confine or retard the flow of ground water are known as aquicludes or aquitards, respectively.

WATER-BEARING UNITS

In the project area, the ground-water reservoir includes three discrete aquifers which consist of parts of either one or two contiguous geologic formations. For identification and discussion, these are designated as the shallow unconfined, the principal, and the deep confined aquifers. In addition to these aquifers, local bodies of perched ground water also are discussed in following sections.

BODIES OF PERCHED WATER

Although bodies of perched water are found at several places in the northern part of the project area, they are not used as a source of water. Areas in which isolated bodies of perched water commonly occur are outlined in figure 5. Perched water occurs close to the land surface in depressions that are underlain by clayey till, particularly in the area of ground moraine north of the Harbor Hill terminal moraine. Perched-water zones also associated with till are common within the Harbor Hill and Ronkonkoma terminal moraines, which are shown in plate 8. A sheet of relatively impermeable older ground moraine from the Ronkonkoma terminal moraine northward to Manhasset Neck causes ground water to be perched, commonly several tens of feet below land surface, in that area. Isolated bodies of perched water are found in clay-bottomed kettle holes within the moraines, in the intermorainal area, and on the outwash plain slightly south of the moraines.

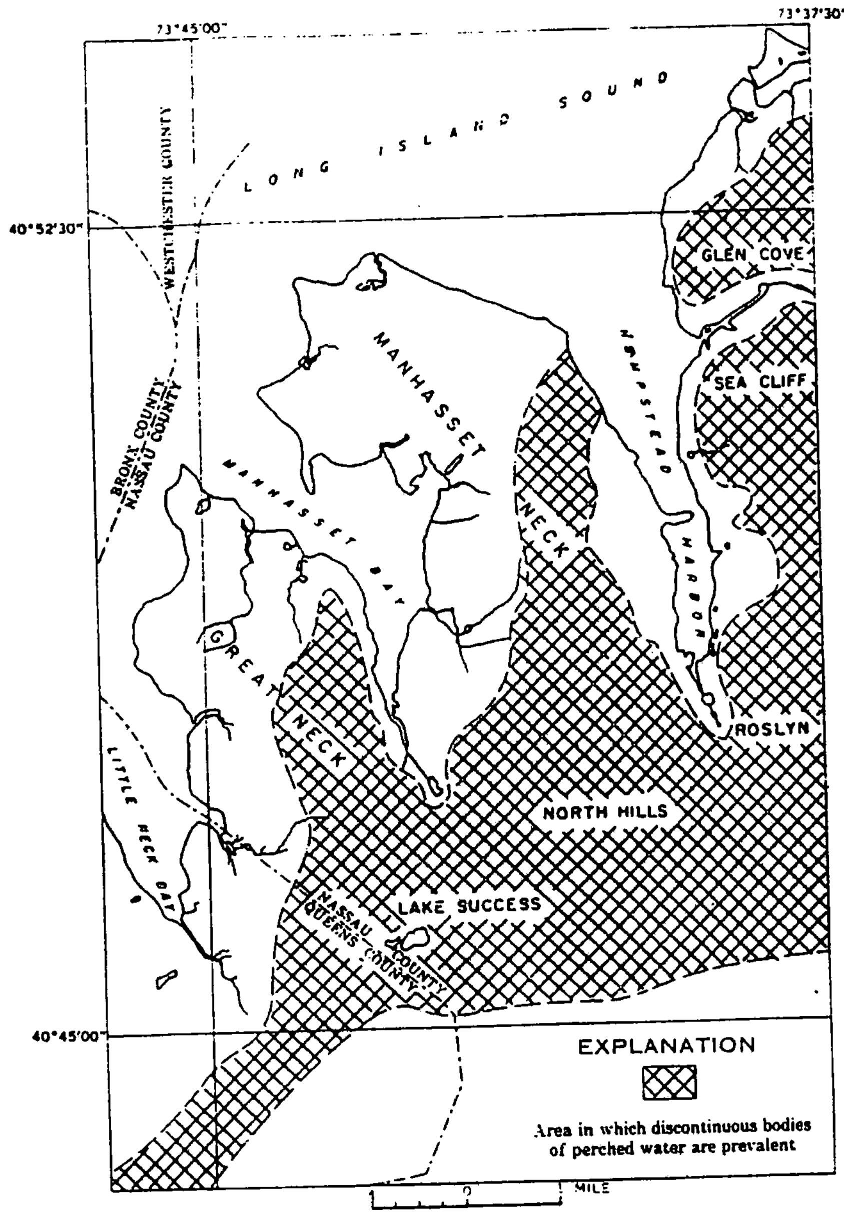


FIGURE 5.—Map of northwestern Nassau and northeastern Queens Counties, N.Y., showing areas of perched water.

SHALLOW UNCONFINED AQUIFER

The shallow unconfined aquifer consists of those permeable Pleistocene and Cretaceous deposits that lie below the main water table and within the upper part of the zone of saturation, from slightly below to a little more than 110 feet above sea level. Contours on the main water table are shown in plate 9. The shallow unconfined aquifer is a source of water where it occurs in sand and gravel deposits, particularly in the glacial outwash plain south of the Harbor Hill terminal moraine. Owing to the irregular distribution of Cretaceous clay and other beds of low permeability within the aquifer in the vicinity of Kings Point and Port Washington, the water-bearing materials in these area are more discontinuous than elsewhere. Nevertheless, small supplies of water are obtained from the aquifer for domestic and industrial purposes in many parts of the Manhasset and Great Neck peninsulas. Also, of considerable importance as sources of water are the permeable deposits in the shallow aquifer in northeastern Queens County and in Sands Point, beyond the northern limit of the principal aquifer—that is, in areas where these deposits lie directly above the clay member of the Raritan formation or the Gardiners clay. In 1957, about 5 mgd (million gallons per day) of ground water was withdrawn from the shallow unconfined aquifer in the project area.

PRINCIPAL AQUIFER

The principal aquifer corresponds approximately to that part of the Magothy(?) formation which occurs from about 50 feet below sea level downward to the top of the clay member of the Raritan formation. In places, moreover, the aquifer includes Pleistocene deposits which blanket the Magothy(?) or lie in channels cut into it. Some pre-Wisconsin channels, which cut to or slightly into the clay member of the Raritan formation and are filled with undifferentiated Pleistocene deposits, have been noted (pls. 4–7), and other channels undoubtedly exit in the area. The channel fill is generally of coarser texture than the adjacent Magothy(?) deposits with which, however, it is hydraulically continuous. The areal extent of the principal aquifer is indicated in plate 10. The principal aquifer terminates in the center of Great and Manhasset Necks, somewhat south of the northern limit of the Cretaceous deposits shown in plate 3. The presence of the clay member of the Raritan formation near sea level and the truncation of the Magothy(?) by erosion limit the extent of the principal aquifer northward (pl. 10). Beyond this limit, the principal aquifer merges with the shallow unconfined aquifer.

Hydrostatic heads in the principal aquifer are commonly from a foot to several feet below those in the shallow unconfined aquifer, except in the Port Washington area, where they are as much as 85 feet lower. Hence, the principal aquifer can receive water by downward movement through permeable and relatively impermeable zones, which include discontinuous clay lenses of both the Magothy(?) and the Pleistocene. Although hydraulic continuity between the shallow unconfined aquifer and the upper part of the principal aquifer, is fairly good locally, artesian conditions generally prevail in the deeper part of the principal aquifer. The principal aquifer is the chief source of water in most of the project area, except the peninsulas. In 1957 about 28 mgd was withdrawn from wells screened in the basal zone of the Magothy(?) formation and other permeable zones in the Magothy(?) and deeper Pleistocene deposits.

DEEP CONFINED AQUIFER

The deep confined aquifer consists of the Lloyd sand member of the Raritan formation and the Jameco gravel and underlies the entire project area. The lower limit of the aquifer is the bedrock surface; the upper limit is the clay member of the Raritan formation and the Gardiners clay. The Gardiners clay may abut the clay member on the north, where the deposits of Cretaceous age have been eroded, or it may lie directly upon the clay member, as it does in some valleys and embayments. Thus, the Lloyd sand member of the Raritan formation (Cretaceous) and the Jameco gravel (Pleistocene) are connected hydraulically in the northern part of Manhasset and Great Necks. The two contiguous clay bodies overlying the aquifer, the clay member of the Raritan formation and the Gardiners clay, form effective confining beds, which probably extend beyond the shoreline of the project area. These stratigraphic relations are shown in three geologic sections (pls. 4–6). The vertical limits of the deep confined aquifer are shown on the hydraulic profile (pl. 12).

As hydrostatic heads in the deep confined aquifer (pl. 11) are commonly from 5 to 50 feet lower than those in overlying aquifers, downward leakage of water from the shallow unconfined and principal aquifers through the clay member of the Raritan formation and the contiguous Gardiners clay is possible in most of the area.

Hydraulically, the deep confined aquifer is the most perfectly confined of the water-bearing units. The degree of confinement is demonstrated by the fact that interference effects in the aquifer are recognized from centers of pumping as much as 10 miles away from the project area. In contrast, the effects of pumping on the principal and shallow unconfined aquifer generally are observed only within a radius of less than half a mile from pumped wells. The deep confined aquifer is a major source of water in the northern part of the project area, particularly on Manhasset and Great Necks. Locally, it is the only source available for large public supplies or industrial needs. About 7 mgd was withdrawn from the aquifer in 1957.

THE WATER TABLE AND PIEZOMETRIC SURFACES

Hydrostatic pressures in each of the aquifers in the project area can be related to a water table or associated piezometric surfaces.

The shape and slope of these surfaces are determined chiefly by the thickness, areal extent, and permeability of the aquifer materials and the quantity of water moving through them. Moreover, each surface expresses a dynamic equilibrium among all factors affecting recharge and discharge relationships, both natural and artificial, within the aquifer. Variations in any one of the factors may produce changes in the position of the surface and concomitant changes in storage and pressure in the aquifer and adjacent aquifers.

The configuration of the water table, which marks the top of the shallow unconfined aquifer, is shown in plate 9 by contours referred to sea level and is based on water-level measurements made in wells during April 1957. From figure 14 it is apparent that a high position, which is also on the main water-table divide of Long Island, lies in the Albertson-East Williston area about 2½ miles south of the Harbor Hill terminal moraine. (Position of moraine shown on pl. 8.) Along this divide, which occurs in relatively permeable outwash deposits, the water table reaches altitudes of 75 to 80 feet above sea level. The water table slopes from the divide area to the northwest, west, and southwest, at gradients of about 5 to 6 feet per mile near the divide, steepening to about 10 feet per mile toward the southwest. In the southern parts of Manhasset and Great Necks, there is a pronounced flattening in the northwesterly slope from the main divide, and near the margins of Little Neck and Manhasset Bays and Hempstead Harbor (pl. 9) the water table assumes steep bayward gradients of 25 to 35 feet per mile. The shape of the water table in the central and northern parts of Manhasset and Great Necks is controlled essentially by local recharge and geologic conditions. More or less isolated ground-water mounds are indicated by closed water-table contours above an altitude of 25 feet on Great Neck and 60 feet on Manhasset Neck. Although the presence of these mounds is favored by the topography of the peninsulas, the high position of the water table is largely the result of zones of low permeability within the zone of saturation. Thus, water-table altitudes of more than 110 feet on Manhasset Neck are due to the presence within the upper part of the ground-water reservoir of rather impermeable till zones and Cretaceous deposits, the latter occurring as buried erosional remnants and ice-shoved masses. Sharply defined troughs in the water table around Little Neck and Manhasset Bays and Hempstead Harbor, and the fact that water-table contours are restricted to land areas, indicate that the shallow unconfined aquifer terminates at the shore lines of these salt-water bodies where ground-water is discharged.

The piezometric surface of the principal aquifer based on measurements in observation wells in April 1957 is shown in plate 10. The shape and slope of the piezometric surface is generally a somewhat subdued replica of the water table (pl. 9). The pronounced mound in the water table on Manhasset Neck is apparently reflected by a ground-water nose in the piezometric surface somewhat west of the high point on the mound. Also, pumping centered around well N2030 has created a marked cone of depression, indicated by the 25-foot depression contour in the piezometric surface, and has locally distorted the shape of the ground-water nose. Troughs in the piezometric surface are focused on Manhasset Bay and Hempstead Harbor and indicate direct ground-water discharge from the principal aquifer to these salt-water bodies. However, in contrast to the shallow unconfined aquifer, the piezometric surface shows that the principal aquifer probably extends beneath the southern parts of these bays but terminates somewhat farther north near the limit of the aquifer, as indicated in plate 10.

The piezometric surface of the deep confined aquifer in April 1957, as shown in plate 11, is based on measurements made 8 to 12 hours after cessation of pumping in most wells tapping this aquifer in the project area. Owing to rapidly changing heads within this aquifer that are caused by pumping, it is difficult to depict a representative piezometric surface. However, the piezometric surface presented in figure 16 may be generally representative for average daily recovery of water levels during most of the year, when withdrawals from the aquifer in the project area average about 6 to 7 mgd. Withdrawals during the summer are considerably larger, as much as 14 mgd in July 1955, and the piezometric surface in July 1955 undoubtedly was markedly different from that shown in figure 16. Depression contours on plate 11 indicate, somewhat schematically, the larger public-supply and industrial pumping centers that were in operation during the spring of 1957. The cones of depression are indicative of partial recovery of water levels after pumping; their gradients and lateral extent vary from day to day, according to the rates of antecedent pumping and the particular combinations of pumping wells. Although the natural shape of the piezometric surface is distorted by pumping effects, it is apparent from plate 11 that the general slope of the surface is westerly—declining from an altitude of somewhat more than 20 feet on the east side of the project area to less than 4 feet on the southwest. Thus, across the project area, the average gradient is about 2 to 3 feet per mile. The closed 14-foot contour in the south-central part of Great Neck may reflect local recharge by downward leakage from the principal aquifer or possibly may be a residual high, comparatively unaffected by nearby pumping. Also the pronounced noses on the piezometric surface in the northern parts of Manhasset and Great Necks presumably indicate local areas of downward leakage from the shallow unconfined aquifer. On the west side of Manhasset Neck is a cone of depression, marked by a re-entrant in the 2-foot contour, in which the piezometric surface has been depressed by pumping to positions considerably below sea level. This situation, of course, is conducive to salt-water encroachment from Manhasset Bay into the deep aquifer. As indicated by the piezometric contours, the deep confined aquifer extends beneath all the land area of the project and probably also beneath Little Neck Bay, Manhasset Bay, and Hempstead Harbor.

RECHARGE

The ground-water reservoir in the project area is replenished under natural conditions solely by precipitation, which in Nassau County averages about 43 inches annually. Of this, perhaps 50 percent reaches the water table at an average recharge rate in Nassau County equivalent to about 1 mgd per square mile. This rate of recharge is probably high for the northern part of the project area, where the relatively steep topography, near-surface till, and Cretaceous clay impede infiltration and increase overland runoff. Thus, recharge to the water table within the project area (63 square miles) may be little more than 55 mgd. Even under optimum conditions, recharge to the water table is chiefly dependent upon precipitation during the season when plant growth is dormant. The infiltration from summer rains is to a large extent intercepted by growing plants, and ground-water replenishment may be negligible during the growing season. Normally, precipitation in Nassau County is fairly evenly distributed throughout the year.

The principal and deep confined aquifers are replenished entirely by downward percolation of water from the shallow unconfined aquifer through the more permeable zones within confining clay bodies and even, directly but slowly, through the clay. Whereas recharge areas for the principal aquifer coincide generally with areas of high water table in the shallow aquifer and flow directions in both aquifers are similar, water in the deep confined aquifer, particularly in the Lloyd sand member of the Raritan formation, apparently originates chiefly in eastern Nassau County—mostly east of the project area. However, the deep confined aquifer also receives local increments of recharge within the project area, as indicated by the contours on its piezometric surface (pl. 11) in Manhasset and Great Necks.

Recharge to the deep confined aquifer through the confining clay may be estimated by application of a modified equation expressing Darcy's law:

$$Q=PIA$$

in which Q is the discharge in gallons per day; P is the coefficient of permeability, in gallons per day per square foot; I is the hydraulic gradient in feet per foot; and A is the cross-sectional area in square feet through which the discharge occurs. Assuming permeabilities of 0.001 to 0.1 for the clay and a head loss of 50 feet through 200 feet of clay, the following recharge rates can be computed:

Permeability	*Recharge (gpd per sq mi)*
0.001	7,000
.01	70,000
.1	700,000

These values, of course, give only possible orders of magnitude for rates of recharge to the deep confined aquifer. They also indicate that the rates may range between wide limits, depending on permeability.

Natural infiltration of precipitation in parts of Nassau County has been disrupted by the growth of densely populated and industrialized areas. The problem of disposing of storm waters from impervious paved areas has been solved by the construction of short storm-sewer lines terminating in recharge basins. Of Nassau County's 425 recharge basins constructed since 1935, about 65 are within the project area. Most of these are south of Northern Boulevard (pl. 1) in populated areas which lack natural drainage channels. Their designed storage capacity is determined by the area to be drained; the basins are commonly 12 to 15 feet deep and range in size from less than 1 to several acres. Storm water seeps from these basins through the underlying sand and gravel deposits to the water table, thereby providing artificial replenishment of the ground-water reservoir. Inasmuch as drainage in much of the project area is poor, some of the basins merely serve as collecting points for storm water, which may ultimately reach a more favorably situated basin by means of overflow drains. Seepage rates from each basin vary according to natural permeabilities of the underlying material, maintenance of the basin, antecedent precipitation, temperature, and head of the collected waters. In an experimental recharge basin near Mineola, infiltration rates ranging from 20 to 400 gpd per square foot under various conditions were determined by the Surface Water Branch of the U.S. Geological Survey (Brice and others, 1959).

Artificial recharge to the water table also is effected by means of cesspools and septic tanks. Thus, perhaps 15 mgd or about half the water pumped for public supply in the project area in 1957 was returned to the ground, while about 15 mgd was discharged as treated sewage directly to Long Island Sound and the ocean. However, the expansion of sanitary sewers discharging to tidewater may eventually eliminate this source of ground-water replenishment. As required by law, most of the ground water pumped in Nassau County for industrial and cooling purposes is returned to the ground by sumps and diffusion wells. Thus, 18.0 mgd or 75 percent of the total industrial pumpage in Nassau County (24.3 mgd) was returned to the ground-water reservoir in 1957. Of 18.0 mgd, it is estimated that about 6 mgd was returned to the ground in the project area.

MOVEMENT

Ground water moves along flow lines from points of high head to points of low head. The rate of movement depends upon the permeability of the materials in the reservoir and relative differences in head. The bulk of ground-water flow in an aquifer is in the direction of the steepest gradient and normal to contour lines, as shown on the water-table (pl. 9) and piezometric maps (pls. 10, 11); yet there may be minor flow components oblique to the principal flow direction. In the shallow unconfined aquifer, most of the water moves from the main water-table divide in the Albertson-East Williston area toward the northwest, west, and southwest (pl. 9). However, in the southern parts of the Manhasset and Great Neck peninsulas, much of the northward and northwestward flow from the main divide is intercepted and diverted laterally by east-west valleys, such as those of the Cutter Mill and Flower Hill drains, that cross the peninsulas. Each of these peninsulas contains a well-developed ground-water mound in the shallow aquifer, and from these mounds the shallow ground water flows radially outward to bounding salt-water bodies. However, from the apices of both mounds, most of the flow apparently is westward because of masses of rather impermeable Cretaceous deposits at altitudes of 50 to more than 100 feet along the eastern margins of both peninsulas.

Ground-water flow in the principal aquifer (pl. 10) is generally westward and northward—similar to that in the shallow unconfined aquifer but not coinciding everywhere. In the area of the main ground-water divide, pressure heads in the principal aquifer are a foot to a few feet lower than the water table, and water moves downward from the shallow aquifer into the principal aquifer. A head difference of approximately 5 feet between the water table (well N1140) and the basal zone of the principal aquifer (well N575) has been observed in Garden City (pl. 12). The vertical interval between the screens of wells N575 and N1140 is about 460 feet, which is the maximum known interval in the project area between the two aquifers. In parts of Port Washington on Manhasset Neck, heads in the principal aquifer are as much as 85 feet lower than those in the shallow aquifer (pls. 9, 10). As little downward movement of water from the shallow unconfined aquifer seems possible in this area because of highly impervious clay bodies, the principal aquifer apparently receives water almost entirely by flow from the south.

Pressure heads in the principal aquifer in an area peripheral to the southern parts of Manhasset Bay and Hempstead Harbor are commonly higher than the water table and also higher than the heads in the deep confined aquifer. Thus, water in this area can move upward into the shallow aquifer or into salt-water bodies as well as downward into the deep confined aquifer. The pressure relationships of shallow, principal, and deep aquifers at the southern ends of Little Neck Bay, Manhasset Bay, and Hempstead Harbor are shown in figure 6. Pres-

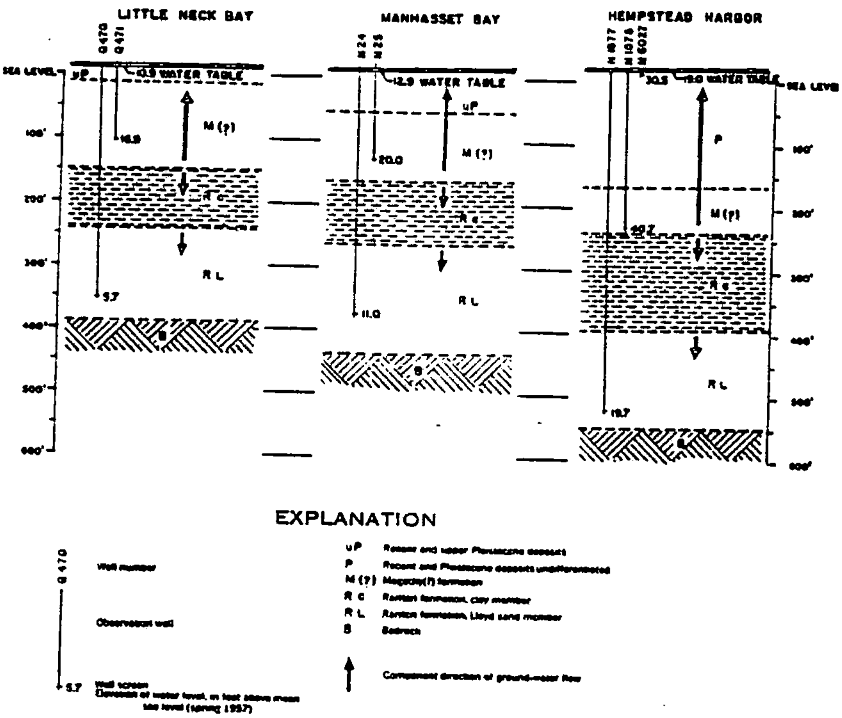


FIGURE 6.—Pressure relationships in shallow and deep wells at selected sites on Little Neck Bay, Manhasset Bay, and Hempstead Harbor, Long Island, N.Y. (1957).

sures in the principal aquifer, above the clay member of the Raritan formation, are generally 6 to 10 feet higher than the water table at corresponding sites. At the southern end of Hempstead Harbor, exceptionally high heads, resulting from recharge to the strata above the clay member from the surrounding high ground, have been observed. At a depth of 12 feet below the land surface, pressures are 10 feet above the land surface, and at the base of the principal aquifer (260 feet below the land surface), pressures are about 20 feet above the surface (see fig. 6).

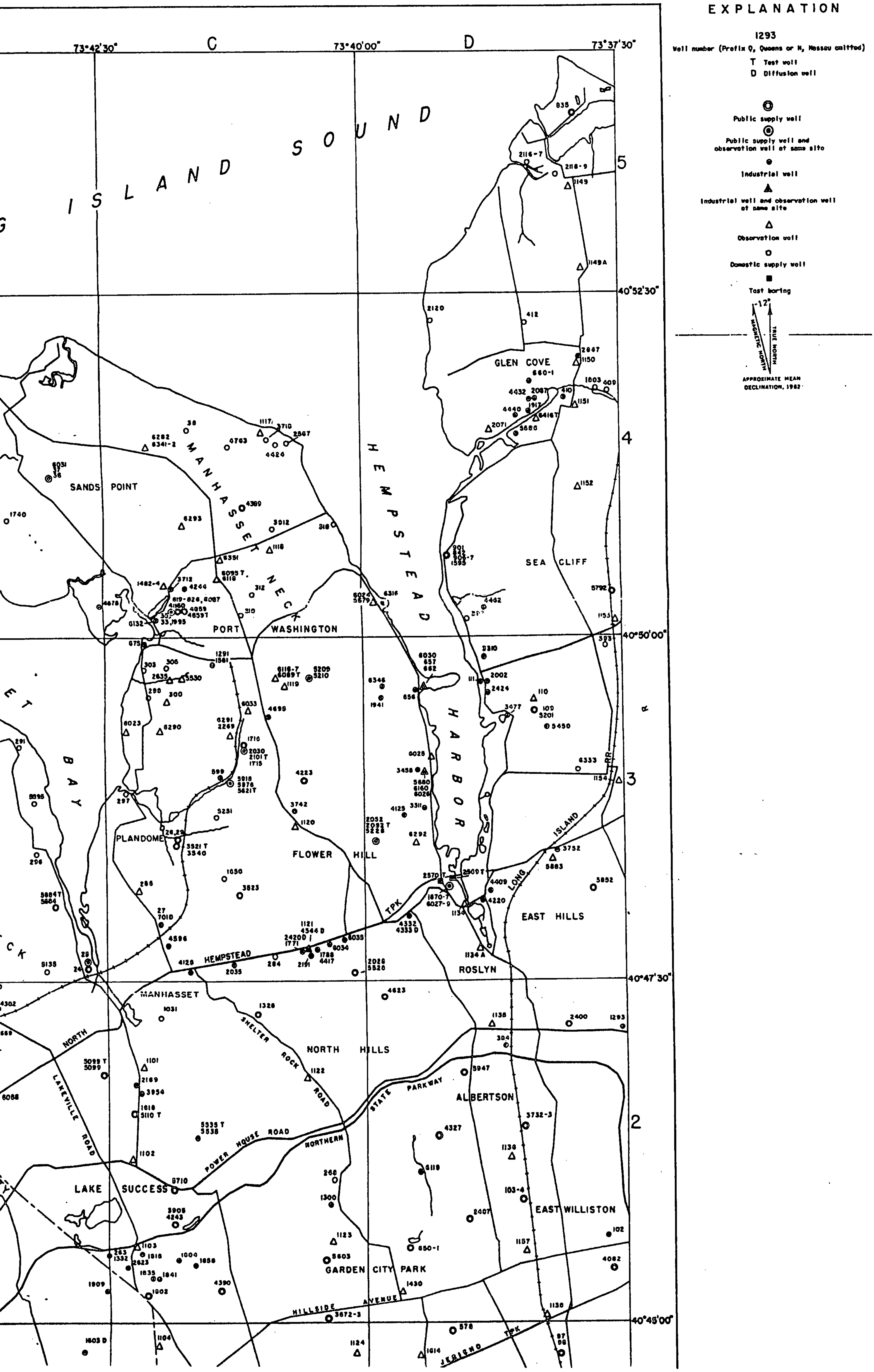
Under natural conditions, the bulk of the water in the deep confined aquifer moves westward across the project area (pl. 11). However, a northerly component flows across Manhasset and Great Necks and Hempstead Harbor toward Long Island Sound. South of the northern limit of the principal aquifer (pl. 10), pressure heads in the deep confined aquifer are commonly from a few feet to as much as 50 feet lower than those in the principal aquifer and water moves downward. North of this limit, in the northern part of Manhasset and Great Necks, the water table in the shallow unconfined aquifer is generally 5 to 20 feet higher than pressure heads in the deep confined aquifer, and water moves downward from the shallow to the deep aquifer.

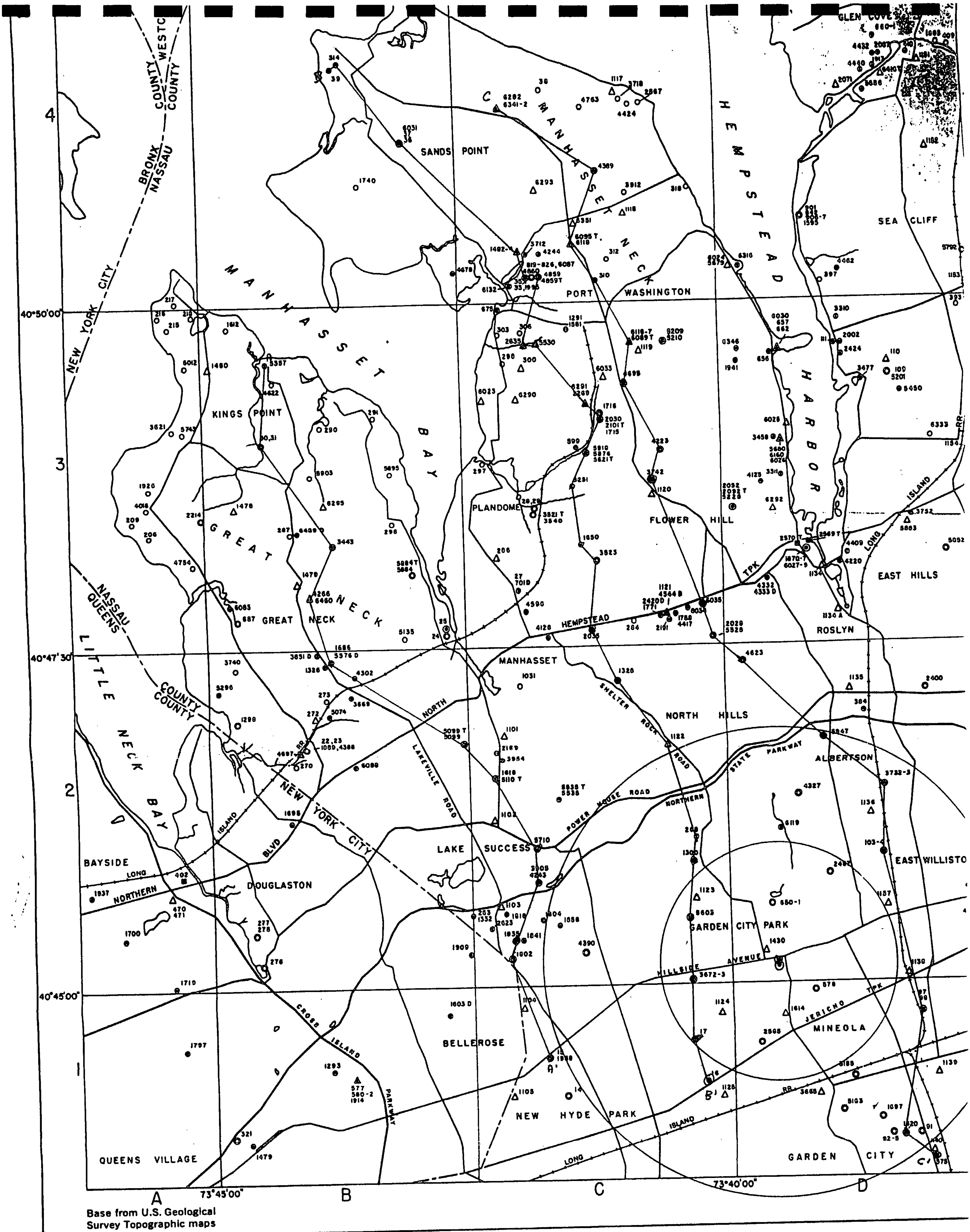
Movement of water in the vertical plane through the ground-water reservoir is demonstrated in a hydraulic profile from Sands Point to Garden City (pl. 12). This profile serves to indicate the relationships of the aquifers, chief confining strata (aquicludes), pressure heads, and principal areas of recharge and discharge. Water levels and piezometric heads are given as of April 1957 and reflect, where measured in supply wells, average recovery periods of 8 to 12 hours after pump shutdown. The line of the profile, shown on plate 9, was chosen to show principal head relationships and flow directions in a typical vertical section through the ground-water reservoir. Inasmuch as flow directions in the shallow, principal, and deep aquifers do not coincide entirely in any one plane of section, some oblique-flow components are necessarily included and labeled as such. Also, the hydraulic profile shows the traces of equipotential surfaces where these are intersected by the line of profile.

DISCHARGE

Ground water is discharged naturally by evapotranspiration, coastal springs, submarine discharge into the salt-water bodies, and effluent seepage into streams that drain into Long Island Sound. Also, water is discharged artificially by withdrawals from wells.

Losses from the zone of saturation through evaporation and transpiration vary seasonally and depend in large degree on the position of the water table with respect to the land surface. In areas where the water table is close to the land surface, moisture is returned to the atmosphere by evaporation from the soil zone and by the transpiration of plants whose roots tap the water table or the capillary fringe above it. Thus, high evapotranspiration rates prevail in some meadow lands, alluvial deposits, and swampy areas, particularly along the north shore and on Great and Manhasset Necks (see pl. 8). Evaporation from the land and from floating pans in the Mineola area, determined by the Surface Water Branch of the U.S. Geological Survey, ranged from 24.53 to 28.08 inches for 7-month periods (April–October)

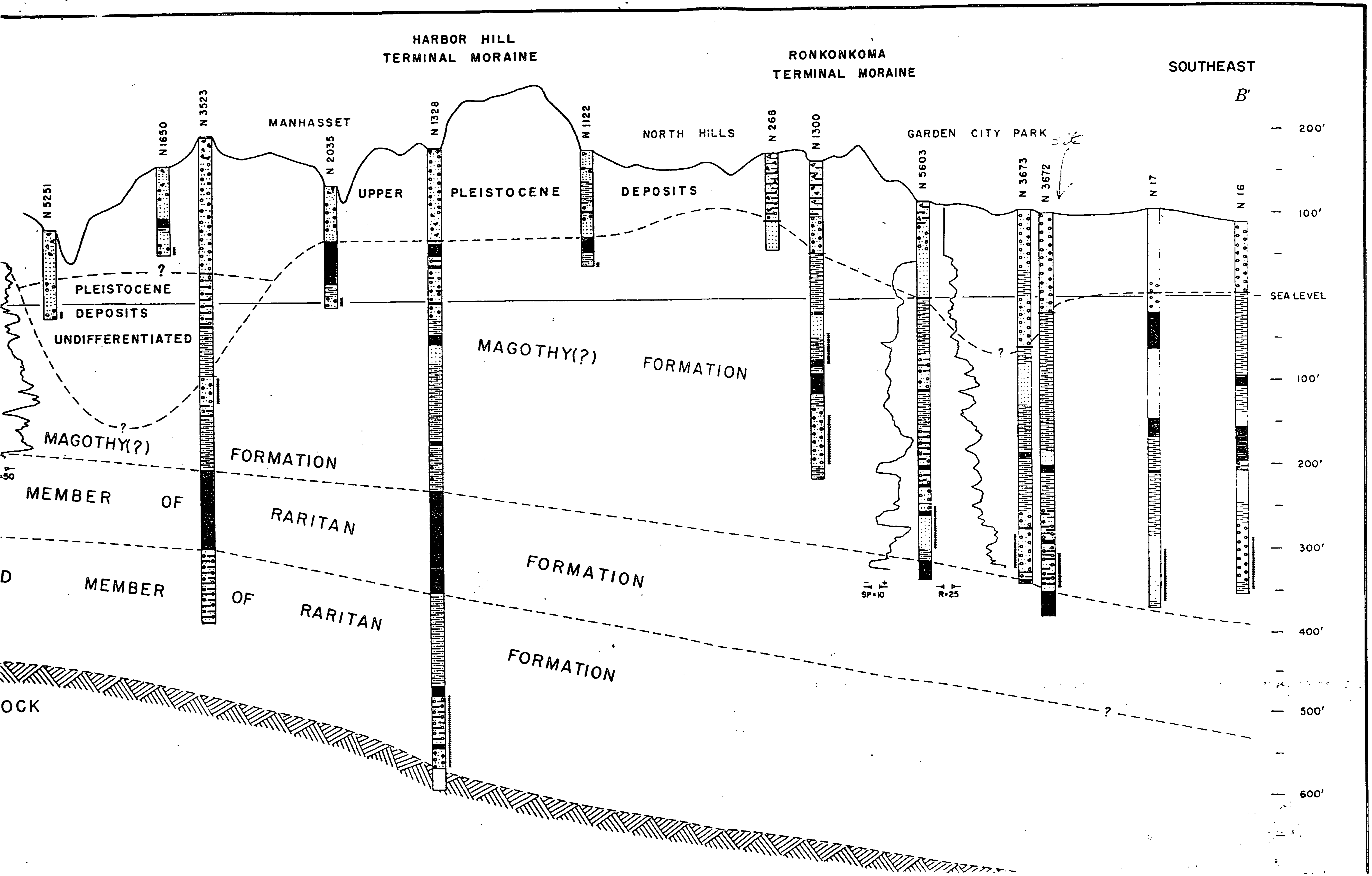

EXPLANATION
1293
Well number (Prefix Q, Queens or N, Nassau omitted)
T Test well
D Diffusion well
Public supply well
Public supply well and observation well at same site
Industrial well
Industrial well and observation well at same site
Observation well
Domestic supply well
Test boring
12°
MAGNETIC NORTH
TRUE NORTH
APPROXIMATE MEAN DECLINATION, 1962
73°42'30"
C
73°40'00"
D
73°37'30"
40°52'30"
40°50'00"
40°47'30"
40°45'00"
5
4
3
2
ISLAND SOUND
GLEN COVE
SANDS POINT
MANHASSET NECK
HEMPSTEAD HARBOR
SEA CLIFF
PORT WASHINGTON
PLANDOME
FLOWER HILL
EAST HILLS
ROSLYN
MANHASSET
NORTH HILLS
ALBERTSON
LAKE SUCCESS
EAST WILLISTON
GARDEN CITY PARK
HEMPSTEAD TPK
LONG ISLAND RR
NORTH HEMPSTEAD
SHELTER ROCK ROAD
NORTHERN STATE PARKWAY
POWER HOUSE ROAD
LAKEVILLE ROAD
HILLSIDE AVENUE
JERICHO TPK

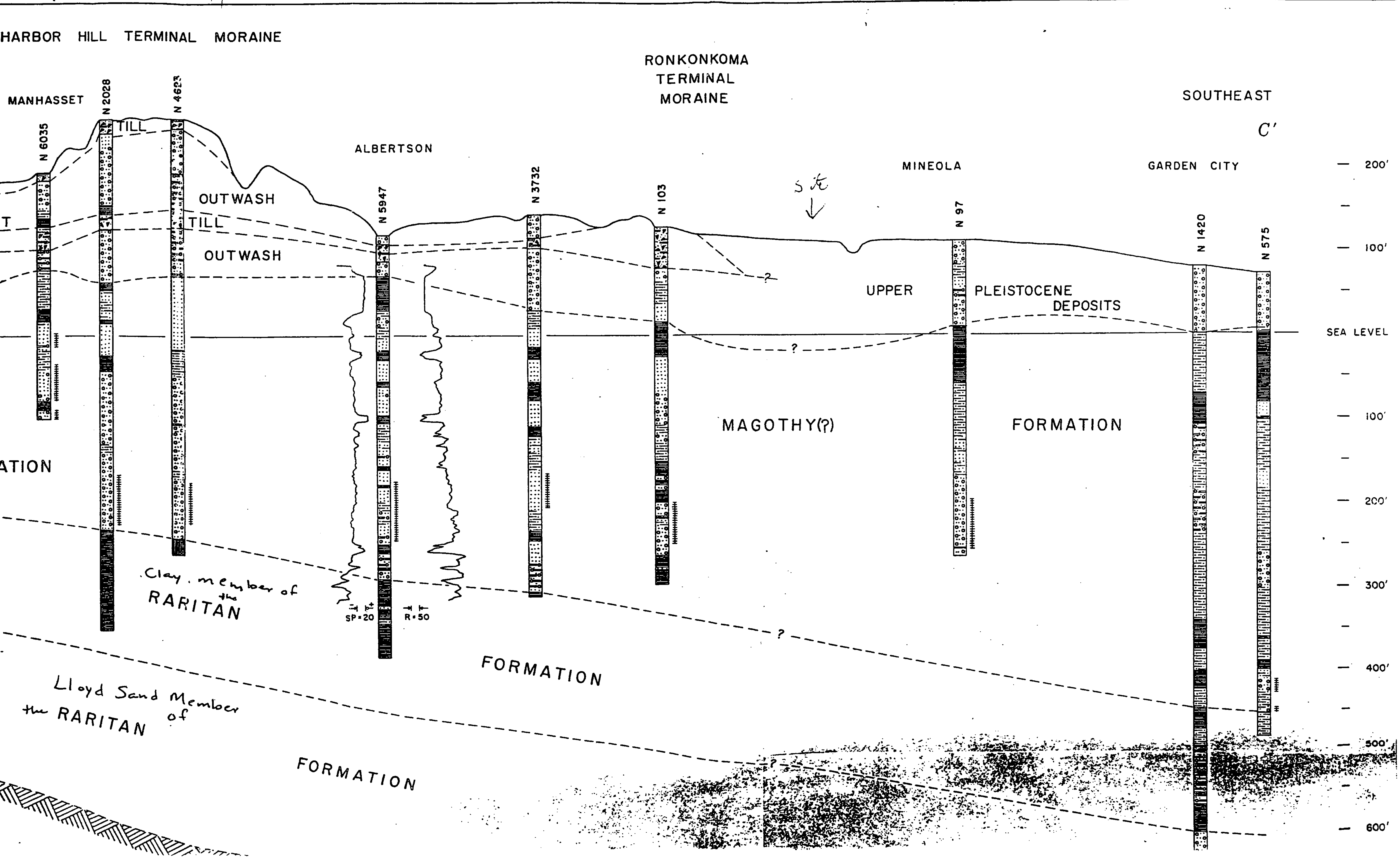


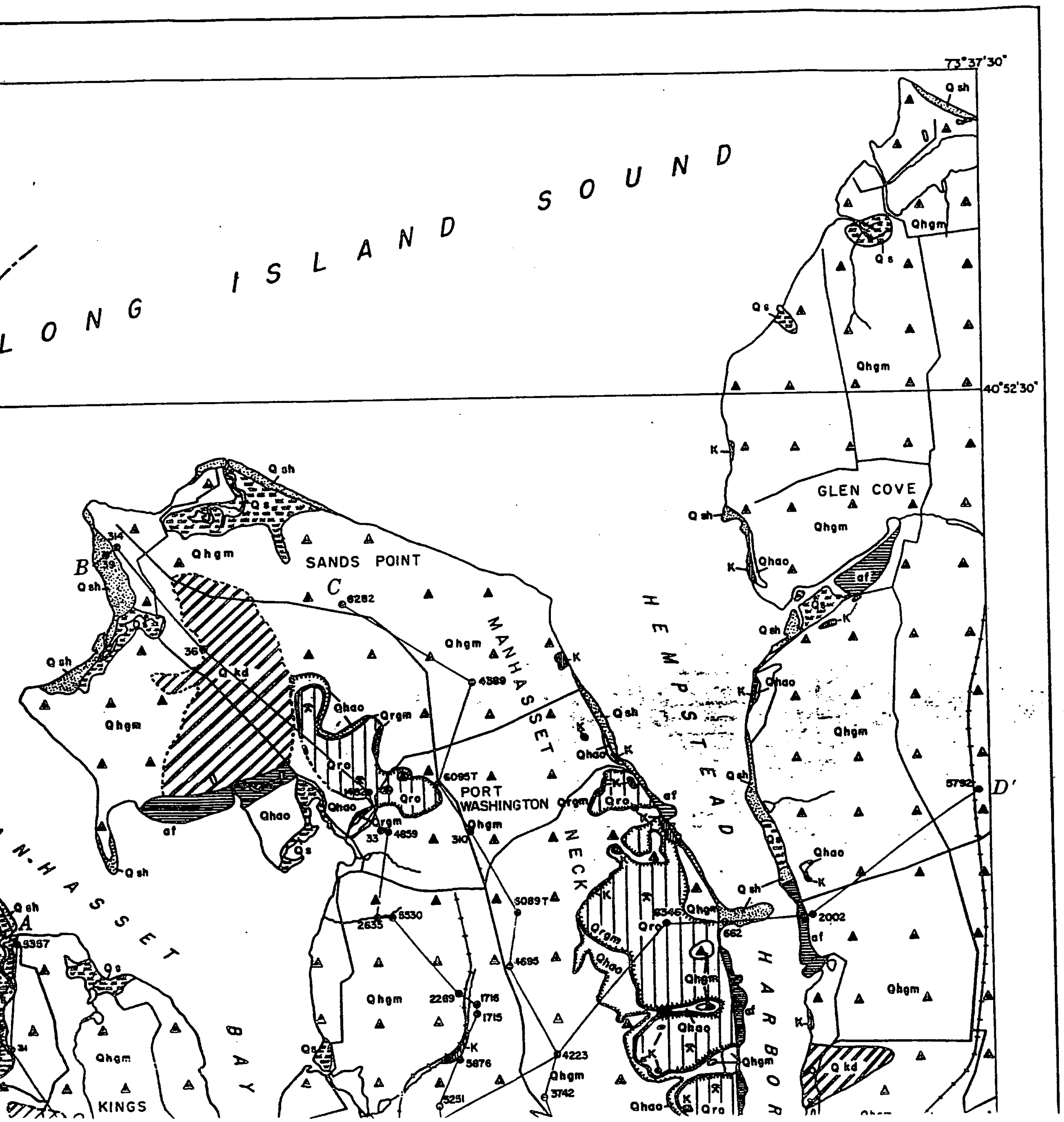
MAP OF NORTHWESTERN NASSAU AND NORTHEASTERN QUEENS COUN
NEW YORK, SHOWING LOCATION OF WELLS AND TEST BORINGS

SCALE 1:48 000

1 ½ 0 1 MILE


HARBOR HILL
TERMINAL MORAINE
RONKONKOMA
TERMINAL MORAINE
SOUTHEAST
B'
N 5251
N 1650
N 3523
MANHASSET
N 2035
N 1328
N 1122
NORTH HILLS
N 268
N 1300
GARDEN CITY PARK
N 5603
N 3673
N 3672
N 17
N 16
UPPER PLEISTOCENE DEPOSITS
PLEISTOCENE
DEPOSITS
UNDIFFERENTIATED
MAGOTHY(?) FORMATION
MAGOTHY(?) FORMATION
MEMBER OF RARITAN FORMATION
D MEMBER OF RARITAN FORMATION
OCK
SP=10
R=25
200'
100'
SEA LEVEL
100'
200'
300'
400'
500'
600'


HARBOR HILL TERMINAL MORAINE
RONKONKOMA TERMINAL MORAINE
SOUTHEAST
C′
MANHASSET
N 6035
N 2028
N 4623
TILL
OUTWASH
TILL
OUTWASH
ALBERTSON
N 5947
N 3732
N 103
MINEOLA
N 97
GARDEN CITY
N 1420
N 575
site
UPPER PLEISTOCENE DEPOSITS
SEA LEVEL
200′
100′
100′
200′
300′
400′
500′
600′
MAGOTHY(?) FORMATION
ATION
Clay member of the RARITAN
FORMATION
SP=20
R=50
Lloyd Sand Member of the RARITAN
FORMATION



EXPLANATION

Qsh
Shoreline deposits
Chiefly well sorted sand, gravel, and pebbles deposited by current and (or) wave action, as beaches, spits, and bars along shore

Qal
Alluvial deposits
Stream-deposited sand and silt; may contain small amount of organic material

Qs
Swamp deposits
Sand, silt, and clay, mixed with decaying plant debris accumulated in marshy areas

Recent

Qoc
Outwash in channels
Stratified sand and gravel deposited in meltwater channels breaching the Harbor Hill terminal moraine

Qop
Outwash plain
Well sorted and stratified sand and gravel of fluvioglacial origin; may include some Ronkonkoma outwash

Qpp
Pitted outwash plain
Outwash plain of sand and gravel with irregular depressions that are due to melting of buried or partly buried ice blocks; may include some Ronkonkoma outwash

Qkt
Kame terrace
Stratified sand and gravel deposited along valley walls by glacial streams

Qkd
Kame delta
Horizontally bedded sand and gravel overlying steeply inclined, well-sorted sand and gravel strata

Qhgm
Harbor Hill ground moraine
Till, unassorted mixture of clay, sand, and boulders deposited by glacial ice. Forming thin veneer over area north of Harbor Hill terminal moraine, average thickness about 5-10 feet, locally as much as 40 feet

Qhtm
Harbor Hill terminal moraine
Thick accumulation of unassorted till and stratified sand and gravel marking stationary front of ice sheet

Qhao
Harbor Hill advance outwash
Well-stratified sand and gravel; largely proglacial outwash from Harbor Hill ice sheet; may include some Ronkonkoma retreatal outwash

Harbor Hill drift

Qrgm
Ronkonkoma ground moraine
Till, unassorted mixture of clay, sand, and boulders deposited by glacial ice. Exposed in gravel pits on Manhasset Neck. Average thickness 5-15 feet; discontinuous and locally grading into stratified sand and gravel

Qrtm
Ronkonkoma terminal moraine
Accumulation of unassorted till and stratified sand and gravel marking stationary front of ice sheet

Qro
Ronkonkoma outwash
Well-stratified sand and gravel; largely proglacial outwash from Ronkonkoma ice sheet

Ronkonkoma drift

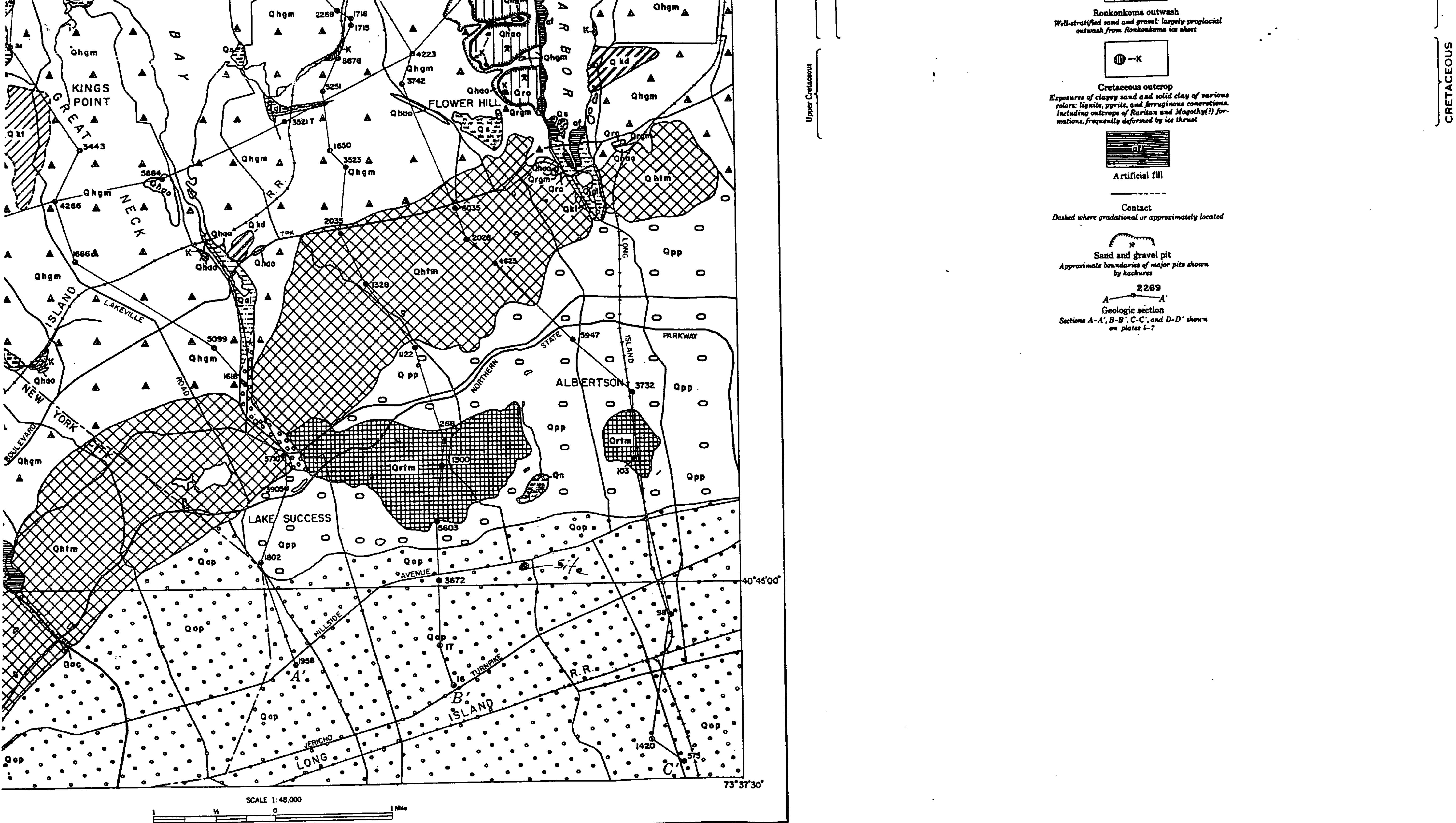
Pleistocene

QUATERNARY

K
Cretaceous outcrop

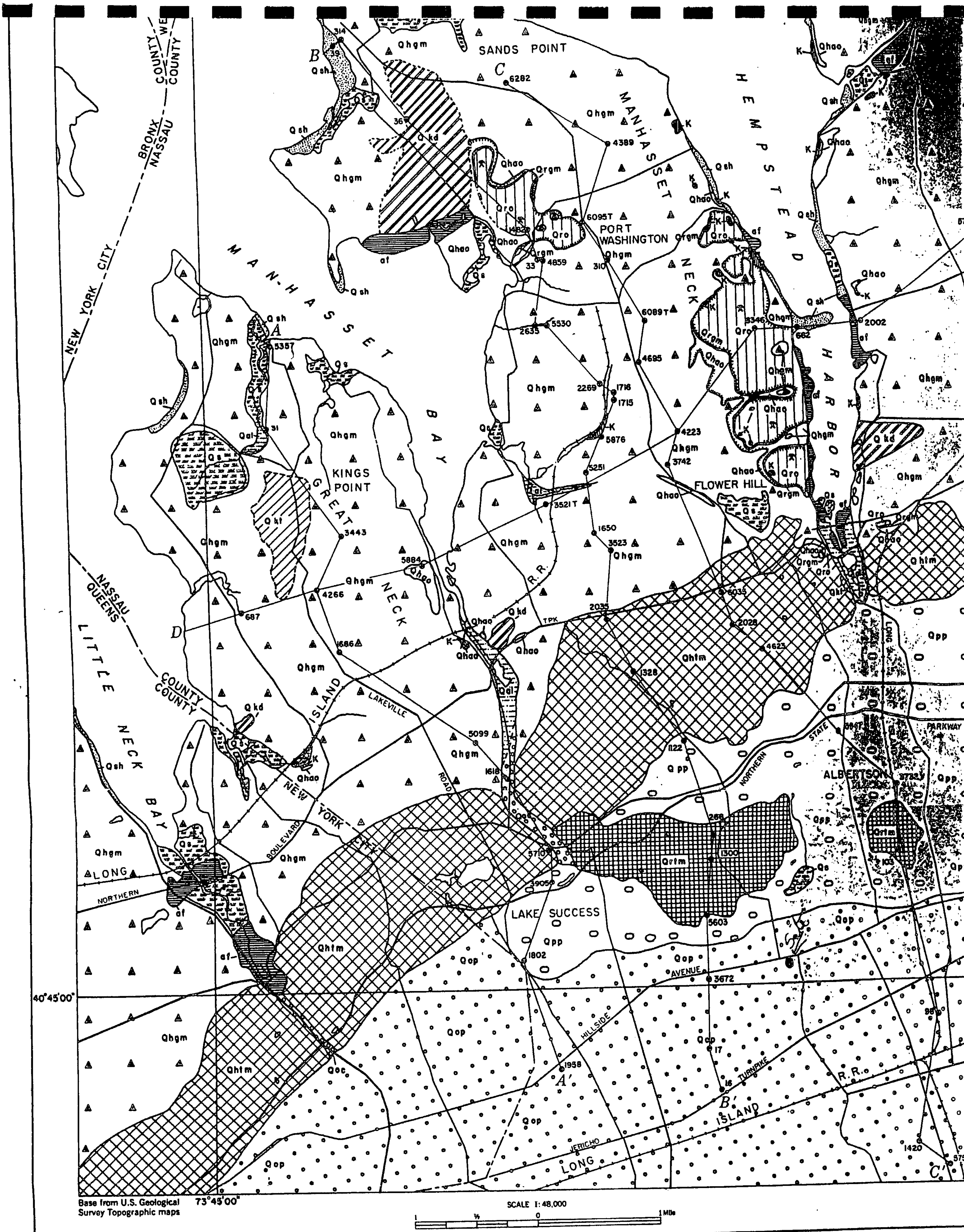
retaceous

ACEOUS



NORTHWESTERN NASSAU AND NORTHEASTERN QUEENS COUNTIES, NEW YORK, SHOWING UNCONSOLIDATED SURFICIAL DEPOSITS

690-188 O - 63 (Plate No. 8)



GEOLOGIC MAP OF NORTHWESTERN NASSAU AND NORTHEASTERN QUEENS COUN

UNITED STATES DEPARTMENT OF THE INTERIOR
GEOLOGICAL SURVEY